Research Note 86-28

EVALUATION OF A SPATIAL DATA MANAGEMENT SYSTEM FOR BASIC SKILLS EDUCATION: PHASE 2

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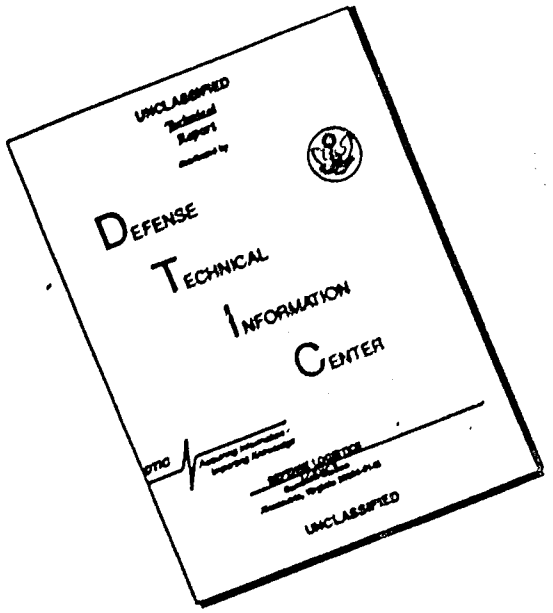

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The Army Basic Skills Education Program needs materials to use in the Army Education Centers to instruct soldiers in the skills and knowledges underlying their job task training. This project designed, developed, and evaluated 12 videodiscs to teach study skills and test-taking strategies, spatial orientation and navigational skills, and other learning strategies.

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Laboratory experiments employed the SDMS materials to investigate the effects of learning strategies and learner control, and of the way the instructional material is organized. Results indicated that the subjects improved their spatial orientation skills after studying the spatial orientation and navigational skills materials, but that the learning strategies and learner control had no differential effects.

A laboratory experiment and a field test investigated the effectiveness of instruction in study skills, test-taking strategies, and test-anxiety reduction in enhancing the ability of soldiers to learn military material. In the laboratory experiment, subjects received different combinations of training in study skills, test-taking strategies, and test-anxiety reduction. Training in study skills improved performance, but this improvement was not maintained when study-skill instruction was combined with instruction in test-taking strategies. Training in test-anxiety reduction was ineffective, both in reducing test anxiety and in producing better performance. In the field experiment, subjects received training in either learning strategies or spatial orientation and navigation skills. Training in both areas reduced test anxiety, with the instruction in spatial orientation skills producing greater reductions. However, neither study skill nor test-anxiety reduction training produced differences in performance measures.

Transfer of the SDMS technology from the research context to the Army Education Centers required decisions regarding the microprocessor systems on which to base it and the evaluation of the system in the field. During the experiments in the laboratory, SDMS was implemented on the Cromemco microprocessor which was plagued with hardware problems. For the field experiment, conducted at the Fort Stewart Education Center, SDMS was implemented on an Apple microprocessor to provide more portable and more reliable delivery. Further applications required an assessment of other microprocessors; therefore, this phase of the research performed an evaluative analysis of potential systems. The main emphasis of the evaluation was the use of SDMS for basic skills education, but general usage was also considered.

Develpoment of a checklist for evaluating the SDMS for basic skills education had as its purpose the indication of the presence or absence of factors related to technology transfer. The checklist development process considered three stages of transfer: Adoption, implementation, and routinization. The original checklist, based on a review of the technology transfer literature, was drafted in an earlier contract. It was tailored to the evaluation of SDMS, but was too long for field use. Thus, in this project, the checklist was refined and shortened. The final format had separate checklists for the viewpoints of the three main groups in the SDMS transfer process (researchers/developers, users, and managers/administrators).

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EVALUATION OF A SPATIAL DATA MANAGEMENT SYSTEM FOR BASIC SKILLS EDUCATION

PHASE II SUMMARY

TECHNICAL PROBLEM AND OBJECTIVES

The Army Basic Skills Education Program (BSEP) needs materials to use in the Army Education Centers to instruct soldiers in the skills and knowledges that underlie their job task training. A potentially applicable technology, evaluated in this project, is the Spatial Data Management System (SDMS). One version of SDMS has a low-cost configuration that integrates microprocessors, videodiscs, and instructional software into an instructional delivery system. Some features that determined the choice of SDMS for this application were:

1) Simplicity, speed, and flexibility of operation.

2) Private, non-threatening learning environment.

3) Interactive movie component with student control of viewing perspective, level of detail, and action.

4) Surrogate travel component with student control of the rate of advance and route of travel.

The current project enhanced the SDMS instructional capabilities by recording and analyzing student responses and providing feedback.

The first phase of the research produced learning materials, refined SDMS for use in the Army Education Centers, and designed laboratory experiments and field test of the materials and system. The major accomplishment was the design, development, production, and programming of twelve videodiscs to teach study skills and test-taking strategies, spatial orientation and navigational skills (SONS), and other learning strategies.

The first phase ended with an interim design review in which HumRRO staff met with personnel from the U.S. Army Research Institute (ARI) to review research progress and determine the objectives for the second phase. Specific objectives determined for this phase were:

1. Produce three more videodiscs, applying learning strategies in the context of the Expert Infantryman's Badge testing.

2. Evaluate the learning strategies, test-taking skills, and SONS materials in experiments and field test.

3. Transfer SDMS to a microcomputer more reliable than the one used in the first phase; an Apple computer was selected.

4. Enhance further technology transfer by conducting a comparative evaluation of the various microcomputer systems that could be used as a hardware base for SDMS, and preparing materials to record transfer factors in Army Education Centers.

APPROACH

Much of the technical approach and methodology for this research have been documented in Phase I reports. Ramsberger, Hopwood, Hargan, and Underhill (1983) reported the principles and techniques applied in design and production of the instructional materials, including the videodiscs, and the lessons learned in the process. Seidel and Wagner (1983) summarized the Phase I progress and a projective cost and training effectiveness analysis of the SDMS to provide a model for future evaluation.

The approach in the second phase continued development of videodisc-based instructional materials, implemented the SDMS on an Apple micro-computer, and executed the experimental and field test designs. The approach to the technology transfer issues had two parts. The first was an evaluative review of six microprocessors to determine their suitability for SDMS implementation. The second was the development of a checklist for assessing transfer of the technology to an Army Education Center, based on a literature review of factors in technology transfer.

RESULTS AND CONCLUSIONS

The 12 videodiscs produced in this project train a variety of study and test-taking skills, spatial and navigational skills, and other learning strategies summarized in Table 1. The prototype discs investigated various video and film techniques. Four test-taking and study skills discs focused on helping soldiers improve their performance on Skill Qualification Tests (SQT). Three SONS discs presented strategies for learning spatial orientation, SONS content, games, and simulated travel exercises. The last three discs, produced in this phase, trained soldiers how to apply learning strategies to information they need to learn. The context was preparation for the Expert Infantryman's Badge.

Laboratory experiments employed the SDMS materials to investigate the effects of learning strategies and learner control, and of the way the instructional material is organized. Learning strategies provide enabling skills rather than supplementary instruction; these strategies help students learn but do not coach them on the material. Results of the experiments indicated that the subjects improved their spatial orientation skills after studying the SONS materials, but that the learning strategies and learner control had no differential effects. Appendix A presents these experiments.

A laboratory experiment and a field test investigated the effectiveness of instruction in study skills, test-taking strategies, and test-anxiety reduction in enhancing the ability of soldiers to learn military material. In the laboratory experiment, subjects received different combinations of training in study skills, test-taking strategies, and test-anxiety reduction. Training in study skills improved performance, but this improvement was not maintained when study-skill instruction was combined with instruction in test-taking strategies. Training in test-anxiety reduction was ineffective, both in reducing test anxiety and in producing better performance. In the field experiment, subjects received training in either learning strategies or spatial orientation and navigation skills. Training in both areas reduced test anxiety, with the instruction in spatial orientation

Table 1. VIDEODISC SUMMARY

Title	No. of Discs	Summary of Contents
Prototype	2	- Opening - SDMS and vicarious travel - Orientation to a line - Shadow-tip method of determining direction - Terrain visualization - Vicarious travel on the mall - Angle pool game - Table of contents
Study Skills and Test-taking Strategies	4	- Preparing for the written SQT - Test-taking skills - Test anxiety reduction (physical relaxation and positive self-talk)
Spatial Orientation and Navigational Skills	3	- Learning strategies (imagery, partitioning, and selective attention) - Learning units on direction finding (cardinal directions, use of sun, shadows, and landmarks) - Games and simulated travel exercises - Tests
Learning Strategies	3	- Information processing techniques - Active rather than pasive learning - Alternative representations of material (flowcharts, mnemonics, pictures, table, etc.) - Practice exercises

skills producing greater reductions. However, neither study skill nor test-anxiety reduction training produced differences in performance measures. The laboratory and field experiments on study and test-taking skills are described in Appendix B.

Transfer of the SDMS technology from the research context to the Army Education Centers required decisions regarding the microprocessor systems on which to base it and the evaluation of the system in the field. During the experiments in the laboratory, SDMS was implemented on the Cromemco microprocessor which was plagued with hardware problems. For the field experiment, conducted at the Fort Stewart Education Center, SDMS was implemented on an Apple microprocessor to provide more portable and more reliable delivery. Further applications required an assessment of other microprocessors; therefore, this phase of the research performed an evaluative analysis of potential systems. The main emphasis of the evaluation was the use of SDMS for basic skills education, but general usage was also considered. The six systems evaluated were the Apple II, Commodore 64, Cromemco, IBM Personal Computer, Osborn 1, and Radio Shack. The analysis of each computer covers five areas: hardware, software, documentation, maintenance, and serviceability. The IBM Personal Computer had the most favorable rating, but all of the computers were weak in two or more areas (Appendix C).

Development of a checklist for evaluating the SDMS for basic skills education had as its purpose the indication of the presence or absence of factors related to technology transfer. The checklist development process considered three stages of transfer: Adoption, implementation, and routinization. The original checklist, based on a review of the technology transfer literature, was drafted in an earlier contract. It was tailored to the evaluation of SDMS, but was too long for field use. Thus, in this project, the checklist was refined and shortened. The final format had separate checklists for the viewpoints of the three main groups in the SDMS transfer process (researchers/developers, users, and managers/administrators). Appendix D presents the development process and the checklists.

IMPLICATIONS FOR FURTHER RESEARCH

Results of this project indicated several future research and development needs. The most compelling was the success of the SONS materials in training basic spatial orientation skills. Recognizing the high priority requirement for these skills among enlisted personnel, a concurrent contract started SONS applications in an Army course for tank commander training.

The learning strategies experiments revealed improvements needed in the materials. Therefore, the concurrent contract also assembled a learning strategies curriculum tailored to Army use. This curriculum requires evaluation and validation before operational use.

The Army is using instructional authoring systems and information delivery systems based on microprocessors. SDMS needs to be aligned with these systems to facilitate transfer to the field. The SONS training for tank commanders, cited above, will be authored and delivered on MicroTICCIT, a system compatible with tri-service initiatives to enhance computer-based training.

APPENDIX A

LEARNING STRATEGIES AND LEARNER CONTROL EFFECTS IN LEARNING SPATIAL ORIENTATION AND NAVIGATIONAL SKILLS

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LEARNING STRATEGIES AND LEARNER CONTROL EFFECTS IN LEARNER CONTROL EFFECTS IN LEARNING SPATIAL ORIENTATION AND NAVIGATIONAL SKILLS

A report released by the National Commission on Excellence in Education (1983) details the decline in educational standards and performance over the past two decades. The evidence cited to document this decline includes the following: 13% of all 17-year olds are functionally illiterate, Scholastic Aptitude Test scores have declined steadily since 1963, and increasing numbers of teenagers are unable to draw inferences, write persuasive essays or solve multi-step mathematical problems. Among the recommendations put forth by the Commission to reverse these trends is the following:

> Instruction in effective study and work skills, which are essential if school and independent time are to be used efficiently, should be introduced in the early grades and continued throughout the student's schooling. (p. 24)

This recommendation reflects an awareness on the part of educators that the central problem faced by many students is that of not knowing how to learn new information and concepts. The result of this awareness has been increased attention given to cognitive skills training, as a means of providing the learner the tools required for information comprehension, storage and retrieval. This effort has involved both research into cognitive processes (see Mayer, 1981, for a recent review), as well as the development of learning strategies curricula.

LEARNING STRATEGIES

These learning strategies programs have been varied in approach. Sticht (1975) developed an embedded strategies program in which soldiers were taught how to employ different techniques and given practice in doing so while learning MOS-related material. Dansereau, McDonald, Collins, Garland, Holley, Diekhoff, and Evans (1979), and Weinstein, Underwood, Wicker, and Cubberly (1979) have developed adjunctive courses which are aimed solely at providing instruction and practice in the application of various learning strategies.

The strategies which have been the subject of this instruction include the following: Method of Loci (Weinstein, et al. 1979), Networking (Dansereau, 1978), Imagery (Bower, 1972), and Systematic Retrieval (Dansereau, et al. 1979). McCombs (1983) cites three groups of strategies: Metacognitive (Brown, Campione, & Day, 1981), Cognitive (Dansereau, 1978; Weinstein, 1978), and Motivational (McCombs, 1982). She outlines a proposed 60-hour course which merges these three areas in 20 modules.

The research on learning strategies training effectiveness has yielded mixed findings, although when courses are carefully adapted to the skill level of students the results are generally positive (Rigney, 1978; Cavert, Jones, Shtogrew, Wagner, Weinstein, & Whitmore, 1980).

LEARNER CONTROL

One of the key concerns occupying educational developers and researchers over the years has been structuring instructional materials in ways which meet the specific needs of individual students. Students differ in attitudes and aptitudes, and these differences have a large impact on their learning. The advent of computers as instructional delivery systems increased the potential for accommodating individual learner differences. The central question which arises is what dimensions and/or characteristics are related to educational success and how can these be accommodated in instructional designs.

One obvious answer to this problem involves increasing the extent to which the student has control over the sequence and pace of the delivery of instruction. As Snow (1980) points out, giving the students control should also encourage them to become independent learners and increase feelings of self-efficiacy. The degree of learner control can, of course, vary widely--from total control over what is seen and when, to isolated decisions to move ahead or review a given lesson. A wide variety of instructional programs have been developed which incorporate some level of learner control, but the research concerning their effectiveness has yielded mixed results (Cronbach & Snow, 1977).

A number of possible explanations for these results have been proffered. One key explanation (Cronbach, 1957) suggests that there is an Aptitude by Treatment Interaction (ATI). Because of the very individual differences we seek to accommodate, some learners may benefit from increased control while others may suffer. Several studies lend support to this explanation. Fry (1972) obtained measures of his subjects' college aptitude and inquisitiveness before assigning them to one of four conditions: student control over what is learned and when, fixed presentation sequence, random presentation sequence, and no-instruction control group. Overall, subjects in the student control group learned the least. However, high-inquisitive, high-aptitude subjects learned significantly more under student control, while low-inquisitive, high-aptitude subjects learned more with the fixed presentation format. Ross and Rakow (1981) also compared learner and problem-controlled instructional formats; the latter were superior when prior student achievement was low, but the control treatment produced no differences when prior student achievement was high.

The amount of time spent with the instructional materials may influence achievement under learner control conditions. Tennyson, Tennyson and Rothen (1980) found that subjects spent significantly less time on-task under learner control conditions than under "adaptive" conditions, where the level of control was varied depending on pre-test data. Tobias (1982) is one of a number of authors who emphasize the importance of time on-task as it relates to learning. If students spend less time with instructional materials when given the option to do so, it is natural to expect that, in many cases, less will be learned.

Another factor important in assessing learner controlled instruction is the student's competence and/or prior experience with the subject matter apart from general aptitude. When a student is beginning a particular course or lesson, he/she may not know enough about the area to be able to effectively control the instructional sequence or pace.

Abramson and Kagen (1975) prefamiliarized students with content of a lesson on heart disease and found that they performed better under low-instructional support conditions, while students who were not prefamiliarized performed better under high-instructional support conditions. Tennyson and colleagues (Rothen & Tennyson, 1978) have designed a system (The Minnesota Adaptive Instructional System--MAIS) which provides a level of control based on student pre-test and in-lesson performance. Thus, the more the student knows at the start, the more control he/she has over the instruction. They found this system superior to student-controlled and non-adaptive systems (Tennyson, Tennyson & Rothen, 1980).

Research evidence, then, suggests that learner-controlled instruction can be highly effective, but that variables such as student aptitude and prior knowledge of the topic must be taken into account when determining lesson structure.

SPATIAL DATA MANAGEMENT SYSTEM

The instruction evaluated in this research was implemented on a computer-based instructional system called the Spatial Data Management System (SDMS). SDMS is a multimedia data retrieval system originally developed by the Architecture Machine Group at the Massachusetts Institute of Technology (Bolt, 1979), and modified to operate on a microcomputer by Levin (1980). The SDMS user accesses video or audio segments, photographs, computer graphics, text, and other information. The information is stored on videodisc, microfiche, or magnetic disc. SDMS introduced a number of innovative techniques to produce a natural user interface, with a joystick and simple function keys for user entry.

SDMS in these experiments was implemented on a Cromemco microcomputer; other components were an industrial videodisc player, a color video monitor, a monochrome control monitor, and an entry control box with joystick and eight buttons. A keyboard is used for authoring, but the students use the simple input devices rather than the keyboard. The software includes an interactive movie subsystem (IMS) and a vicarious travel subsystem. The instructional designer uses the IMS to create a course consisting of interrelated video segments or single frames from a videodisc. The IMS program controls the order of presentation of the segments; the order can be based on the student's responses. In addition, the user can take a simulated trip through a geographic area using the joystick to move forward or backward and to control the rate of travel.

EXPERIMENT I: EFFECTS OF LEARNING STRATEGIES ON SONS LEARNING

This research assessed the effects of learning strategies instruction on the acquisition and performance of spatial orientation and navigation skills (SONS). The learning strategies experimental manipulation used two videodisc learning strategies modules. The first concerned the use of imagery in learning facts and other information. The second focused on grouping or categorizing as a means of simplifying and learning procedures, lists and directions. Visual imagery and partitioning were selected because a review of the literature showed that they could be readily applied to the SONS subject matter, and could be effectively communicated through interactive videodisc. Two hypotheses guided this research:

1. Learning strategies training will increase subjects' ability to acquire and employ orientation and navigation skills.

2. Use of these strategies (whether they were trained or not) will increase subjects' ability to acquire and employ orientation and navigation skills.

METHOD

Subjects

The participants in the study were 18 males and 41 females recruited through advertisements placed in local newspapers in the Washington DC area. They were paid the minimum wage for participating and received a bonus payment if they passed the on-line post-test. The mean age was 20.56 with an average of 12.9 years of school completed. Individuals who responded to the advertisement completed a screening test, the Road-map Test of Direction Sense (Money, 1976). This 32-item test indicates difficulty in left-right directional orientation. Individuals who made 4 or more errors on the test qualified as subjects and were scheduled for five, 2-hour sessions over five consecutive days. The average number of mistakes on the road-map test made by those participating in the study was 6.96.

Instructional Materials

The subjects studied the SONS material, including basic learning units, games, and simulated travel exercises. The basic learning units are short presentations (under 3 minutes) covering directional facts, tips, and procedures. Interactive quizzes assess the student's acquisition. Topics include: (a) cardinal directions (North, East, South, West, Northwest, Northeast, Southwest, and Southeast) and their relationships; (b) use of sun and shadows to determine cardinal directions; (c) left-right distinctions from the viewer's perspective, from the direction traveled, and on the basis of common conventions (e.g., a car's right side); use of landmarks in planning and retracing a route.

Two path learning games serve as memory exercises. One shows an animated car traveling a grid "map" of city streets. The student must remember and follow the path, making the same left and right turns. Rounds of this game vary in difficulty and points are awarded accordingly. Another game with the same objectives presents a vehicle in a minefield.

Vicarious travel segments require students to demonstrate knowledge of directional facts and information from the basic learning units. Students must follow directions presented in a "trip" in dramatized "adventures." Other exercises require the student to memorize directions and perform the vicarious travel. These exercises use both urban and rural environments.

Procedure

Pre-tests. Subjects completed three pre-tests. One was from the Washington Pre-College Test (Form D). This Spatial Ability test (20 items) measures the ability to visualize how two-dimensional figures would look in three dimensions if folded along certain lines. The second was the vocabulary section (40 items) from the Test of Adult Basic Education (TABE), a test adapted from the California Achievement Test (CTB/McGraw Hill, 1976). The last was an on-line pre-test consisting of: 18 questions on cardinal directions, use of sun and shadows to determine direction, and left-right distinctions; four travel exercises in which the student followed directions with the directions in view on the control screen; and travel exercises in which the student had to memorize the directions.

Experimental design. Four experimental groups contained subjects who did or did not receive instruction in learning strategies, and subjects who did or did not use the strategies. Of the 59 subjects, 28 received the learning strategies while the remainder did not. The two learning strategies units covered the use of grouping and imagery as strategies for learning new information. After experimental training sessions were completed, subjects reported in a questionnaire what techniques they used to memorize directions and routes. Based on these responses (two items), subjects were categorized into two of four groups, contingent on whether they received learning strategies instructon and whether they reported using the strategies.

Schedule. The experimenter explained payment procedures and privacy rights to the subjects when they arrived at the test site and administered the pre-tests. At this point, the experimental manipulation (learning strategies instruction for 28 of the subjects) was introduced. Subjects then studied the SONS instructional materials for between four and five hours spread over three days. They completed an on-line post-test identical to the on-line pre-test. They also retook the Road-map Test of Directional Sense and completed the exit questionnaire.

Results

Table A-1 shows the numbers of subjects in each of the learning strategies groups. Only a slightly higher percentage of those receiving learning strategies instruction (compared to those who did not) reported actually using such strategies (46.4% as compared to 38.7%). Providing instruction in learning strategies did not ensure their use.

Table A-1. NUMBER OF SUBJECTS USING LEARNING STRATEGIES AND RECEIVING LEARNING STRATEGIES INSTRUCTION

	Used Learning Strategies	Did Not Use Learning Strategies	Total
Learning Strategies Instruction	13	15	28
No Learning Strategies Instruction	12	19	31
Total	25	34	

Table A-2 provides means, by experimental group, on the four pre-instruction measures. No significant differences between groups were indicated by t-tests on each of the measures.

Table A-2. PRE-INSTRUCTION MEANS BY EXPERIMENTAL GROUPS

	Road-map Pre-Test	Spatial Abilities Test	TABE	On-Line Pre-Test
Learning Strategies	7.0 (4.33)*	10.54 (5.08)	34.79 (7.75)	41.17 (5.38)
No Learning Strategies	6.97 (2.79)	8.58 (4.30)	33.74 (7.68)	40.39 (4.62)

*Variances are in parentheses

Table A-3 presents the means for the pre-instruction measures for the used/did not use learning strategies groups. Once again, no significant differences were found between the group means.

Table A-3. PRE-INSTRUCTION MEANS BY LEARNING STRATEGIES USAGE

	Road-Map Pre-Test	Spatial Abilities Test	TABE	On-Line Pre-Test
Used Learning Strategies	7.40* (3.94)	8.20 (4.01)	32.24 (9.20)	39.44 (4.65)
Did Not Use Learning Strategies	6.68 (3.30)	10.47 (5.06)	35.71 (6.04)	41.74 (5.04)

*Variances are in parentheses

Tables A-4 and A-5 present means of post-instruction measures by received instruction/did not receive and used strategies/did not use. Only one pair of means comes close to being significantly different, that between the learning strategies use/no use groups on the pre-post difference measure ($t = -1.9396$, $p = .058$).

Table A-4. POST-INSTRUCTION MEANS BY EXPERIMENTAL GROUPS

	Road-Map Test	On-Line Post-Test	Pre-Post Difference
Learning Strategies Instruction	1.96 (2.81)*	49.46 (4.51)	8.36 (5.27)
Did Not Receive Learning Strategies Instruction	2.19 (3.55)	48.61 (3.90)	8.23 (5.02)

*Variances are in parentheses

Table A-5. POST-INSTRUCTION MEANS BY LEARNING STRATEGIES USAGE

	Road-Map Test	On-Line Post-Test	Pre-Post Difference
Used Learning Strategies	2.8 (2.91)*	49.2 (4.36)	9.8 (5.55)
Did Not Use Learning Strategies	1.56 (3.33)	48.9 (4.05)	7.15 (4.50)

*Variances are in parentheses

Difference scores were computed for the Road-map pre- and post-tests and for the on-line pre- and post-tests. Those scores were found to be significantly different from zero (Road-map pre-post, $t = 9.89$, $p < .001$; on-line pre-post $t = 12.48$, $p < .001$). Subjects, across groups, improved their scores on these tests significantly.

Analysis of covariance was performed to test for effects of learning strategies use and learning strategies instruction on post-test scores, with post-test scores adjusted to account for pre-test results. No significant effects were uncovered for either of the independent variables on any of the dependent variables.

A general linear models procedure was run to test for interaction effects between the conditions and initial ability/knowledge as assessed by the pre-tests. These analyses revealed a significant relationship between pre and post Road-map tests when class is learning strategy use ($F[1,49] = 9.13$, $p < .01$), and when class is learning strategies instruction ($F[1,49] = 10.18$, $p < .01$). The relationship between TABE scores and post-test scores are also significant (Class = learning strategies use, TABE/pre-post difference $F[1,49] = 8.85$, $p < .01$; TABE/post-test total $F[1,49] = 8.64$, $p < .01$;TABE/Road-map post-test $F[1,49] = 15.59$, $p < .001$; Class = learning strategies instruction, TABE/pre-post difference $F[1,49] = 8.72$, $p < .01$); TABE/post-test total $F[1,49] = 8.63$, $p < .01$). None of the pre-test by condition interactions were significant.

DISCUSSION

The instruction in spatial orientation and navigational skills significantly improved performance of all experimental groups. However, the experimental treatments (instruction in and use of learning strategies) did not produce differential results.

The SONS instructional effects are confounded with effects of pre-testing on SONS topics (the Road-map test, spatial abilities test, and on-line pre-test). Furthermore, a test practice effect may exist, since pre- and post-tests were identical. Further research could investigate pre-test

effects by including a group of subjects who have only the tests (without the instruction) and a group who have only the instruction (without the pre-tests). The pre-testing effects would not be serious in an Army context, however; soldiers go through cycles of testing and training so that tests are a part of the learning experience.

The exit questionnaire items regarding use of strategies were, in effect, a check on the experimental treatment (learning strategies instruction). Only half of those who received the strategies instruction used them. The effectiveness of the learning strategies instruction has no other indices; the materials themselves may not be effective.

In addition to the issue of instructional fidelity, there is also the concern of time. Subjects, many probably unfamiliar with these strategies, may not become effective users of them after a couple of hours of training. Even when given a chance to employ the strategies within the imagery and grouping units, many subjects indicated that they used other strategies to memorize information. Subjects undoubtedly brought their own learning methods to this environment and may have relied more on them than on the strategies recommended.

The method for determining whether the strategies were employed is also somewhat suspect. First of all, it was a self-report measure. Although this was the only method available for making this determination, self-report measures often lack validity (Nisbett & Wilson, 1977). In addition, there was no attempt made to assess the degree to which the strategies were employed. Did the subject who indicated he used imagery to memorize paths do so consistently or once in a while? With some indication of this, a more refined test of the hypothesis might have been possible.

Finally, there is the question of whether these strategies were the most effective and/or easiest methods available for the tasks at hand. It might be easier, for instance, to simply memorize a series of lefts and rights than to try to break the list up or form some appropriate mental image. Perhaps methods other than imagery and grouping were equally as effective with the tasks of interest here.

The lack of positive effects related to training in, or subject use of learning strategies should not be construed as an indictment of either learning strategies or the instructional materials. The possible explanations for the results suggested here indicate that more research needs to be carried out to discover exactly why these results were obtained. Among other things, this work might focus on the amount of time spent on teaching strategies and on practice applications. How much time is required to effectively teach these skills and at what point will students become comfortable enough with the strategies that they will employ them rather than the less effective techniques they used in the past? In future research, there should also be a focus on alternate methods of learning the information of interest, aside from the strategies being taught. It may well be that equally effective techniques are available and are being used by subjects. Finally, it would be valuable to develop more refined techniques for ascertaining what strategies are being used. Perhaps, in the end, self-report measures will have to be relied on, but even then, more subtle measures could probably be developed.

EXPERIMENT II: LEARNER CONTROL

This experiment investigated the effects of learner control on learning. SDMS/IMS offers a great deal of flexibility in the way lessons are structured. A data plane can be created on which units are placed, giving the student complete freedom to browse and select instructional material. On the opposite extreme, lessons can be highly structured so that the student sees units in an order completely determined by the author. The question is, what effect does this have on learning? Do the learner control results achieved with other instructional methods apply in this type of learning environment?

Another structural question concerns the placement of instruction relative to exercises and games. Is instruction given in a functional context (i.e., at the time when the information is to be applied) more effective than that delivered prior to actual application?

To examine these questions, the SONS training materials were structured to vary the level of student control and placement of the instructional segments in relation to games and exercises. The hypothesis guiding the research can generally be stated as follows: Certain formats for organizing and presenting information using the SDMS and IMS are more instructionally effective than others, depending on the spatial and other abilities of the students.

METHOD

Subjects and Instructional Materials

The subjects and instructional materials (SONS) were the same as for the first experiment. Assignment of subjects was counterbalanced across experimental conditions in this experiment to avoid systematic effects of the learning strategies manipulation in the first experiment.

Procedure

Pre-tests. Pre-tests were the same as for the first experiment.

Experimental design. Subjects were randomly assigned to one of four experimental conditions.

(1) Loosely Constrained Topical (LCT). The basic learning units (BLU) were arranged on a data plane and were viewed before starting games or exercises. The subject selected the order of the games or exercises. The BLUs were also available for review when the subject chose to do so or was directed because of mistakes.

(2) Loosely Constrained Functional (LCF). This condition was identical to LCT except that subjects immediately started the games and exercises. As in LCT, they could try them in any order and BLUs were available should the subject appear to need help or choose to see them.

(3) Moderately Constrained Functional (MCF). Once again, the subject began with games and exercises which could be viewed in any order. The BLUs were only seen when the subject was having trouble with a particular concept. In this case, however, the subject was forced to see the learning unit which dealt with this problem, then returned to the point in the game or exercise where the trouble began.

(4) Strictly Controlled Functional (SCF). These subjects had no choice of order. They started with car games, went to minefield games, and so on through the instruction. Remediation was also system controlled.

Schedule. After the pre-tests, the subjects studied the SONS materials for between four and five hours spread over three days. Subjects in the MCF, LCF and LCT groups could stop at any time in the fifth hour and take the on-line post-test. Those on the SCF group had to finish the entire program or were stopped after five hours if they had not.

Post-tests. The on-line post-test was similar to the pre-test. The order of the items was changed and six additional travel exercises were added (two that required memorization and four that did not). The additional items are not included in the comparisons with the pre-tests. Subjects also repeated the Road-map Test of Direction Sense. They completed an exit questionnaire, and when possible, supplied additional comments to the experimenter.

Results

Table A-6 presents the means for each of the experimental groups on four pre-instruction measures. No significant differences were found by t-tests between the groups on any of the pre-instruction measures.

Table A-7 shows the mean post-experimental measures by group. When these means are adjusted to account for pre-experimental scores, comparisons reveal only one significant difference between them, that between SCF and LCF on the Road-map Test ($t[51] = 2.02$, $p < .05$).

Difference scores were computed for pre- and post-test results on the Road-map and on-line tests. These scores were found to be significantly different from zero (Road-map pre- and post-tests, $t = 9.89$ $p < .001$; on-line pre- and post-tests, $t = 12.48$, $p < .001$). Subjects across groups improved their scores on these tests significantly. Unfortunately, there is no way of knowing how much of a practice effect existed, given that all the post-tests were identical to the pre-tests.

Table A-6. PRE-TEST MEANS BY GROUP

	Road Map Test	Spatial Abilities Test	TABE	On-Line Pre-Test
SCF N=14	7.14 (4.43)*	10.93 (4.98)	33.50 (8.19)	40.86 (5.19)
LCF N=13	6.46 (2.54)	10.23 (4.51)	36.15 (3.44)	41.50 (5.39)
LCT N=16	6.44 (3.63)	8.50 (5.19)	33.81 (8.24)	39.62 (5.64)
MCF N=16	7.81 (3.54)	8.69 (4.27)	33.75 (9.36)	41.25 (3.86)

*Variances are in parentheses

Table A-7. POST-TEST MEANS BY GROUP

	Road-map Test	On-line Post-Test	Pre-Test Difference	Time on Task (Hours)
SCF N=14	3.50 (5.73)*	48.78 (4.79)	7.93 (5.74)	6.41 (1.04)
LCF N=13	.92 (1.32)	49.54 (3.26)	8.15 (4.76)	6.37 (0.79)
LCT N=16	1.50 (1.67)	48.81 (4.32)	9.19 (5.14)	6.78 (.91)
MCF N=16	2.37 (1.82)	49.00 (4.38)	7.81 (5.11)	6.63 (1.11)

*Variances are in parentheses

In an effort to isolate any effects of order of presentation or degree of learner control, analyses of covariance were performed in which post-test scores were adjusted to account for pre-test differences. No significant effects were found for group membership on either the post-test ($F[3,55] = .06$, $p = .97$), or the Road-map Test ($F[3,55] = 1.61$, $p = .15$).

It is possible, given the research results cited earlier, that effects are being masked due to individual differences of subjects within operational treatment groups. A general linear models procedure was run for the dependent variable on-line post-test and Road-map post-test, in which condition Road-map pre-test, Spatial Test score, TABE score, on-line pre-test scores and interactions between condition and the other measures were entered into the model. No significant effects were found when the post-test was the dependent variable. With the Road-map post-test, the TABE ($F[1,39] = 8.57$, $p < .01$), Road-map pre-test by condition ($F[3,39] = 12.51$, $p < .01$), and TABE by condition ($F[3,39] = 4.17$, $p < .01$) effects were all significant. It was unclear why the TABE should have a significant relationship to the Road-map post-test performance. The correlation between the two was $-.48$ ($p < .01$). If the TABE (which in this case is a vocabulary test) can be considered a test of general ability, then this relationship would be expected. Both the TABE by condition and Road-map pre-test by condition can be traced to outliers in the sample. Regressions of the Road-map pre-test or the Road-map post-test and TABE on the Road-map post-test revealed little relationship in the LCF, LCT and MCF groups, but a significant relationship in the SCF group (TABE, $F[1,12] = 14.50$, $p < .01$; Road-map pre-test $F[1,12] = 20.674$, $p < .01$). Examination of the raw data points to the most likely explanation for this effect: two subjects had Road-map pre-test scores of 19 and 15, with Road-map post-test scores of 12 and 19 respectively. These subjects had correspondingly low TABE scores of 21 and 18.

Exit Questionnaire Data

At the conclusion of the experiment, subjects were asked to rate both the system and the instructional materials on a number of dimensions.

The system. Each of the system components was rated on a five-point scale, with five being the most favorable rating. In those cases where multiple questions were asked about a component, the ratings were combined. The new ratings were as follows: Button box - 3.66; Joystick - 4.59; Color monitor - 4.70; Black and white monitor - 4.50; and Computer materials (i.e., box labels) - 4.81. The relatively low rating for the buttons reflects the fact that subjects sometimes had to depress them more than once before the system responded. The mean rating of how easy the system was to learn (1 = very easy; 4 = very hard) was 1.23. The system, therefore, seemed easy for this group of subjects to learn and use.

Instructional materials. Subjects were asked to indicate how much they enjoyed each of the units (5 = liked it a lot; 1 = disliked it a lot) and how difficult they thought each game/exercise was (4 = very hard; 1 = very easy). Mean ratings on these dimensions were high (Table A-8). Those exercises which are rated as more difficult also tend to be rated less favorably. The correlations between difficulty and enjoyability are -.45 ($p < .001$) for the car games, -.36 ($p < .01$) for the minefield games, and -.31 ($p < .05$) for the memory travel exercises. The other enjoyment-difficulty correlations are not significant.

Table A-8. MEAN ENJOYABILITY DIFFICULTY RATING

Unit	Enjoyment	Difficulty
Pre-test	3.66	2.33
L/R Car	3.93	--
L/R Person	3.99	--
L/R Ball	3.81	--
Compass Headings	4.28	--
Direction Quiz Room	4.07	--
Sun & Shadows	4.05	--
Landmarks	3.83	--
Car Games	3.62	2.62
Minefield Games	3.26	3.02
Kidnapped Adventure	4.42	2.12
Tied to the Track	4.48	2.12
Memory Travel	4.44	2.34
Post-Test	4.29	1.98

DISCUSSION

The performance of all groups improved significantly in spatial orientation and navigation skills. Compared to pre-test scores, on-line post-test scores were significantly higher and significantly fewer mistakes were made on the second Road-map Test. However, the experimental conditions did not produce differential effects.

One possible reason for the lack of effects may be the weakness of the manipulations. The topical and functional groups differed only in the fact that subjects in the former saw the BLUs before any games or exercises. From then on, they functioned similarly. The effect of the manipulation may have been lessened by the requirement that all subjects spend at least four hours

with the material and urging them to go through all of the exercises and games. Thus, although MCF and LCF/LCT subjects had more "freedom of choice" than did those in the SCF group, their experiences were instructionally equivalent.

This similarity was reflected in the time spent on-task (between six and seven hours for each group). One explanation for poor performance under learner-control conditions is that students spend less time with materials when given the opportunity to do so. In this research they spent about the same time. If time on-task has played an important role in the research on learner control conducted thus far, we would not expect group differences since there is so little difference between the groups on this variable.

Another explanation for lack of time-on-task differences may be that subjects enjoyed the materials and wanted to spend time going through them. This suggestion is supported by the high enjoyability ratings by the subjects. This factor, in combination with the new and unique instructional medium may have overpowered the effects of the organization and structure of the materials.

Random assignment of subjects appeared to produce experimental groups similar in their pre-existing spatial abilities, as measured by the tests (Road-map Test, on-line pre-test, and spatial ability test). Pre-existing ability is one of the factors hypothesized to effect whether learner control is or is not effective; since the groups did not differ in prior ability, the treatment effects would not be expected on the basis of prior ability. A future test of these effects would have to use groups that were stratified on the basis of pre-existing ability.

SUMMARY

Subjects received between six and seven hours of interactive videodisc instruction and practice in spatial orientation and navigation. Post-test performance was significantly higher than pre-test, regardless of experimental treatments that varied the learner control and learning strategies. The lack of treatment effects may result from the weakness of the manipulations, especially given the power of the instructional medium.

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APPENDIX B

EFFECTIVENESS OF VIDEODISC INSTRUCTION IN LEARNING STRATEGIES

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EFFECTIVENESS OF VIDEODISC INSTRUCTION IN LEARNING STRATEGIES

Introduction

In recent years, enlisted personnel within all branches of the Armed Services have shown a marked need for remedial education in the basic skills underlying effective learning and performance of job skills. In response to this need, the U. S. Army has established programs to upgrade the reading, speaking, listening, writing, and computation skills of its enlisted personnel. To date, however, these programs have met with limited success. Consequently, in April 1979, the Secretary of the Army directed a review of the Army Continuing Education System (ACES). The resulting recommendations, designed to broaden and improve ACES services, led to a decision to redesign, over the next five years, the Basic Skills Education Program (BSEP), a major component of the ACES. According to the resulting plan, the U. S. Army Training and Doctrine Command (TRADOC) is charged with developing new BSEP curricula, and the U. S. Army Research Institute (ARI) is to expand its mission in basic skills research.

The first phase of the redesigned program (BSEP I) will be coordinated with initial entry training (IET). The second phase (BSEP II) will be designed for post-IET delivery, and will focus on prerequisite skills for successful progress to skill level 20 or grade E5 during a soldier's first-term duty assignment.

One of the primary components addressed in the BSEP II curriculum development project is learning strategies. According to TRADOC Regulation 621-1, learning strategies are:

> skills that contribute to efficient and independent learning by improving the soldiers ability to acquire, process and store, and retrieve information.

This focus on learning strategies as a fundamental capability desirable in all soldiers comes at a time when solutions are actively being sought for the incresed cost of military training. The notion of soldiers able to study independently and effectively, and to assimilate and apply the contents of MOS-related training is extremely attractive. Establishment of such independent learning capacities would very likely improve the level of personnel performance and cause a concomitant reduction in training time, manpower, and monetary requirements.

Learning Strategies

The efficient learner uses a variety of both cognitive and affective learning strategies to aid in acquisition, retention, and retrieval of information (O'Neil and Spielberger, 1979). These learning skills include good study habits, effective memorization procedures, anxiety management techniques, and methods to provide optimal motivation.

Cognitive Learning Strategies

Cognitive learning strategies include both active study strategies, which provide for an organized method of studying to enhance learning; and information processing strategies, which enhance acquisition, retention, and retrieval of specific information (Weinstein, 1982). A variety of programs has been developed to teach active study procedures. Many of these have been based on the study-question-read-recall-review (SQ3R) technique (Robinson, 1946). These programs have been criticized because they often assume that students do not need training in how to perform the individual steps of the procedure (Dansereau, McDonald, Collins, Garland, Holley, Diekhoff, & Evans, 1979). As a result of this problem, Dansereau and his colleagues have developed a learning strategies curriculum which teaches specific strategies for comprehension-retention and retrieval-utilization of information (Dansereau, 1978; Dansereau et al., 1979). Other recent learning strategy curricula (e.g., Weinstein, Underwood, Wicker, & Cubberly, 1979; McCombs, Dobrovolny, & Judd, 1979) have also taught study strategies at a more specific level.

Information processing strategies are methods to aid acquisition, retention, or retrieval of information. These methods generally are designed to force students to process information at deeper, semantic or imaginal, levels of processing, rather than at shallower levels (see Craik & Lockhart, 1972). These methods include verbal and imaginal elaboration (Weinstein, 1978; Weinstein et al., 1979), and a variety of other memory aids (see Norman, 1969).

Affective Learning Strategies

A major affective factor that reduces performance is anxiety. Anxiety that occurs in the face of tests can often lead to poor test performance. Spielberger, Gonzalez, and Fletcher (1979) have reviewed the research in the measurement and control of test-anxiety. A number of behavioral and cognitive techniques have been shown to be effective in reducing test anxiety. Specifically, both desensitization training (Anton, cited in Spielberger et al., 1979) and relaxation training (Bendell, cited in Spielberger et al., 1979) have been shown to be effective methods for test-anxiety reduction. Cognitive methods may also be effective in reducing test anxiety. For example, Weinstein (1982) suggests a program of instruction to replace negative self-talk with positive self-talk in test situations. Although these methods have

been shown to decrease test anxiety, they have not improved measures of performance, such as grade point average, without additional training in study-skill strategies (Gonzalez, cited in Spielberger et al., 1979).

Learning Strategies Instruction

The learning strategies instruction evaluated in this research was implemented on a computer instructional system called the Spatial Data Management system (SDMS). SDMS is a multimedia data retrieval system originally developed by the Architecture Machine Group at the Massachusetts Institute of Technology (Bolt, 1979), and modified to operate on a microcomputer by Levin (1980). Using SDMS, an individual may access video or audio segments, photographs, computer graphics, text, and other information. The information may be stored on videodisc, microfiche, or magnetic disk. SDMS introduced a number of innovative techniques to produce an exceedingly natural user interface, involving the use of joysticks and function keys.

The version of SDMS used in these experiments was implemented on a Cromemco microcomputer. The components of the system include the Z-80 based microcomputer, an industrial videodisc player, a color video monitor, a monochrome control monitor, and a control box with a joystick and eight buttons. A keyboard is also included with the system to be used for authoring. Students using SDMS do not use the keyboard to interact with the system. The software components of SDMS include an interactive movie subsystem (IMS), and a vicarious travel subsystem. The IMS allows the instructional designer to create a course consisting of interrelated video segments or single frames from a videodisc. The segments that are presented to a student and the order of presentation are controlled by the IMS program and may depend on student responses. The vicarious travel subsystem allows the user to take a simulated trip through some geographic area using the joystick to move forward and backward and to control the rate of travel.

Four videodiscs were developed containing instructional material in test-anxiety reduction (TAR), study skills, and test-taking strategies. In addition, three videodiscs were developed containing instruction in spatial orientation and navigational skills (SONS). The SONS material was used as a control in Experiment 2. The individual programs in these areas are described below.

Test-anxiety Reduction

The goal of the unit on test-anxiety reduction is to allow the student to recognize the symptoms and consequences of test-anxiety, and to manage it using positive self-talk and physical relaxation. Separate segments address these two techniques for test-anxiety management.

The segment on positive self-talk demonstrates how soldiers can replace negative self-talk with positive self-talk to reduce test anxiety. The steps in this process include recognizing negative self-talk, stopping negative self-talk, replacing negative self-talk with positive self-talk, and returning attention to the study task or test. Students are given opportunities to practice this technique in various settings, including study environments, approaching a test, before a test, and during a test. The instruction takes approximately 1.5 hours to complete.

The segment on physical relaxation introduces two techniques for relaxing in the face of test anxiety: Deep muscle relaxation and slow deep breathing. Students are guided by a model to learn these techniques. Students are then provided opportunities to practice the techniques in several environments including in a pleasant setting, in study environments, approaching tests, and during written tests. The instruction lasts approximately 1.5 hours.

Study Skills

The goal of this unit is to teach students the skills they need in order to study and retain information required to perform successfully on Skill Qualification Tests (SQT). The unit presents a highly structured procedure for studying for the written or skill component of the SQT containing the following four steps: Determining what you need to know, locating the necessary information, learning the information, and reviewing the information. The specific study skills that are introduced and demonstrated in the unit include highlighting and underlining, questioning, paraphrasing, and quizzing yourself. These techniques are presented during an interactive movie, and students are able to review specific techniques or steps in the study procedure whenever they wish. Interactive practice exercises are provided to correspond with this unit. The instruction takes approximately 2.5 hours to complete.

Test-taking Strategies

This unit presents specific techniques students can use to ensure that their performance on written multiple choice examinations accurately reflects their knowledge of the material. Test-taking tips are presented which cover the following topics: preparing for the test, understanding the directions, budgeting time, answering easy and hard questions, guessing in an informal manner, using clues in questions, and checking answers and answer sheets. Students then use these test-taking tips in an interactive exercise to answer questions similar to those on an SQT. The instruction lasts approximately one hour.

Navigational Skills Training

The instruction on spatial orientation and navigational skills included both presentations of information and interactive exercises which cover direction facts, tips, and procedures. Topics covered in the presentations include information on distinguishing left and right from different viewpoints; distinguishing north, south, east, and west; using the sun in direction finding; and using landmarks in navigation. The exercises include vicarious travel segments and memory games which require students to demonstrate the knowledge of the direction facts described in the presentations. Additional exercises instruct the student on military navigational tasks.

Experiment 1

The goal of Experiment 1 was to investigate the effectiveness of training in combinations of cognitive and affective learning strategies in increasing the ability of BSEP II soldiers to learn military information. Specifically we were investigating the following hypotheses:

1. Instruction in study skills will enhance the ability of soldiers to learn military material, especially for soldiers who have low test anxiety.

2. Instruction in test-taking strategies will produce further gains in learning ability.

3. Instruction in test-anxiety reduction will reduce test anxiety and will thereby lead to increased learning ability when combined with training in study skills and test-taking strategies.

To test these hypotheses, we performed an experiment in which both BSEP II soldiers and civilians received various combinations of training in study skills, test-taking strategies, and test-anxiety reduction, and were subsequently tested on their ability to learn selected military material.

Method

Subjects

The 123 subjects included 114 males and 9 females. Twelve of the subjects were paid volunteers drawn from National Guard and Army Reserve units in the Washington DC area. The remaining 111 subjects were BSEP II students from Ft. Myer VA and Ft. Stewart GA. It was originally intended that subjects be selected to represent high or low levels of test anxiety as measured by the Test Anxiety Inventory (TAI; Spielberger,

Gonzolez, Taylor, Algaze, & Anton, 1978). However, the pool of available subjects was not large enough to allow us to make this selection.

Instructional materials

Two forms of instruction in study skills and test-taking strategies were developed. The first was implemented using SDMS, as described in the Introduction. In addition, a paper version of the instruction was created to serve as a control to test the effectiveness of the SDMS as a instructional delivery tool. TAR instruction was only presented on SDMS.

Experimental Design

There were two experimental and two control groups in the study. The first experimental group, the SSTT group, received on-line instruction in study skills and test-taking strategies. The second group, the TAR group, received instruction in test-anxiety reduction, in addition to study skills and test-taking strategies. The No Instruction control group received no instruction in any of the learning strategies. Finally, the Hard Copy (HC) control group received paper-based instruction on study skills and test-taking strategies. A third control group, who studied the paper-based material at home, was envisioned in the original design of this experiment. However, interviews of the subjects in this group revealed that none had actually studied the home-study material. Consequently, the data from this group were combined with that from the No Instruction control group.

All subjects studied and took quizzes on three military topics. The first quiz occurred before any instruction in learning strategies was presented. TAR and study-skill instruction occurred between the first and the second quiz, for those subjects who had this training. Instruction in test-taking strategies occurred between the second and third quizzes.

Data

Data consist of entry tests, dependent measures, and an exit questionnaire.

Entry Tests. Subjects filled out a background questionnaire which included information about the highest enducational level attained. Civilian subjects completed the vocabulary portion of the Test of Adult Basic Education (TABE); for military subjects these scores were obtained from the Army. All subjects filled out a modified version of the Survey of Study Habits and Attitudes (SSHA; Brown & Holtzman, 1955), the TAI, and a Test of Selected Military Knowledge (TSMK) developed specifically for this experiment. Only the Work Methods (WM) and Delay Avoidance (DA) subscales of the SSHA were used. In addition, the wording of some of the questions was modified to make the questions more appropriate for a military setting. The TSMK is a series of 12 multiple-choice

questions on a variety of military topics. A copy of this test is shown in Annex A.

Dependent measures. In order to test the effectiveness of the learning strategy instruction, the soldiers were given military material to study and were subsequently tested on that material. The study material was excerpted from military manuals and was presented to the subjects in the form of a study booklet. The quizzes consisted of twenty multiple-choice questions on information covered in the study material. There were three sets of study material and quizzes. Topics covered in the quizzes were: (1) Administer first aid in a toxic environment; (2) Administer first aid for common emergencies; and (3) Marking of contaminated or dangerous land areas. Copies of the study material and quizzes are in Annex B.

Exit questionnaire. At the conclusion of the experiment, the subjects who had received instruction on SDMS completed an exit questionnaire which assessed their impressions of the system, and their evaluation of each of the kinds of instruction that they received. A copy of this questionnaire is in Annex C. In addition, subjects completed the TAI. To the extent that was possible, scores for the TABE taken after the experiment were obtained from the Army.

Procedure

The experiment took place on three days within a single week. On the first day, the subjects completed the background information form, the TAI, the modified SSHA, the TSMK. In addition, they studied for and took the first quiz, on first aid in a toxic environment. On the second day, the subjects received training in learning strategies according to their experimental group; following this training, they studied for and took the second quiz, on first aid for common emergencies. Subjects in No Instruction control group received no learning strategy instruction. Subjects in the Hard Copy control group received paper-based instruction in study skills. Subjects in group SSTT received computer-based instruction in study skills. Finally, subjects in group TAR received computer-based instruction in both TAR and study skills. On the second day subjects in the Hard Copy, SSTT, and TAR groups received instruction in test-taking strategies; this instruction was computer-based for the SSTT and TAR groups. All subjects then studied for and took the third quiz, on marking of dangerous or contaminated land areas. Following the third quiz, all subjects took the TAI. Subjects in the TTSS and TAR groups also completed the exit questionnaire.

Results

Data consist of entry test scores, measures of reading comprehension on the military tasks, and exit questionnaires.

Differences Between Subject Samples

The entry test scores and scores on the first quiz for military and civilian (i.e., National Guard and Army Reserve) subjects were compared to ensure that these samples could be analyzed together. T-tests were used to compare the means. Because of the large difference in the size of the two samples, the tests are very sensitive to differences in variance between the two samples. Consequently, we used separate estimates of variance for the two samples, rather than using the pooled variance estimate.

Table B-1 shows the difference between the groups on education, TAI subscale and total score, TABE verbal raw score, SSHA subscales, TSMK, and the score on the first quiz. The tests indicate that the civilian group is better educated than the regular Army soldiers. However, there are no significant differences on any of the other variables. The results suggest that the military and civilian subjects may be combined in a single analysis.

Table B-1
Means of Entry Measures for Military and Civilian Subjects

	Civilian		Military		
Variable	Mean	Std Dev	Mean	Std Dev	T(df)
Education	4.500	0.904	3.350	1.109	4.08(15)*
TAI (Emotion)	19.333	7.050	15.459	4.645	1.86(12)
TAI (Worry)	16.000	5.737	15.324	4.834	0.39(13)
TAI (Total)	41.167	14.288	38.757	11.253	0.57(12)
TABE	542.500	80.412	524.292	71.404	0.75(13)
SSHA (DA)	17.083	4.295	15.595	8.420	1.01(22)
SSHA (WM)	20.083	4.795	18.649	9.196	0.88(21)
TSMK	3.333	1.231	3.829	1.892	-1.24(17)
Quiz 1 Score	11.917	2.193	12.653	3.097	-1.04(17)

* $p < .01$

Test Anxiety and Performance

The effect of instruction in test-anxiety reduction on performance may be assessed directly by comparing the quiz scores of those subjects who received the training to those who did not. However, the maximum possible effect of TAR instruction depends on the degree to which quiz performance depends on test anxiety, and the extent to which test anxiety is reduced by instruction.

Correlations between Quiz 1 scores and entry measures indicate a significant relationship between Quiz 1 scores and the scores for TABE ($r = 0.35$, $p < .01$) and TSMK ($r = 0.30$, $p < .01$). The correlation between Quiz 1 scores and the total TAI score is near zero ($r = 0.01$) and insignificant. Thus, we would not expect training in test-anxiety reduction to produce appreciable improvement in performance on the remaining quizes.

The TAI was given both before and after the TAR instruction. The effectiveness of TAR instruction in reducing test anxiety as measured by the TAI was assessed by comparing the post-experimental TAI total score between the group that received TAR instruction and the groups that did not receive the instruction. Scores were adjusted to account for pre-experimental differences in test anxiety. The results of the analysis show no reductions in test anxiety as a result of TAR instruction ($t[7] = 0.42$, $p > .50$). However, these results should be interpreted in light of the fact that only seven of the subjects who received TAR instruction completed both the pre- and post-experimental TAI's. Nevertheless, a large effect of TAR instruction on quiz performance would not be expected.

Effects of Instruction on Performance

The effects of instruction on performance were assessed using an analysis of covariance on quiz scores with earlier quiz scores as covariates. More specifically, group differences in Quiz 2 adjusted for scores on Quiz 1 were used to assess the effects of study skills and test-anxiety reduction instruction. Group differences in Quiz 3 scores adjusted for scores on Quiz 2 were used to assess the effects of instruction on test-taking strategies both alone and in combination with instruction in test-anxiety reduction. In addition to the overall analysis of covariance, specific adjusted means were compared using t-tests. Since the contrasts of interest could be specified in advance, and since the number of contrasts of interest was relatively small, t-tests were appropriate for these comparisons.

Overall, differences among scores on Quiz 2, adjusted for Quiz 1, were significant ($F[3,104] = 3.08$, $p < .05$). Scores for the SSTT group were significantly higher than both the No Instruction group ($t[104] = 2.93$, $p < .01$), and for the Hard Copy Control group ($t[104] = 2.06$, $p < .05$).

TAR instruction did not increase the effectiveness of the training in Study Skills; the adjusted performance of the TAR group was actually lower than both the No Instruction control group ($t[104] = 0.15$) and the SSTT group ($t[104] = 1.89$), although neither difference was significant.

Differences among scores on Quiz 3, adjusted for Quiz 2 were not significant ($F[3,97] = 2.24$, $p < .10$). Examination of the individual comparisons revealed that the SSTT group performed significantly worse than the Hard Copy Control ($t[97] = 2.39$, $p < .05$). The difference between the SSTT group and the No Instruction Control was not significant ($t[97] = 0.93$); nor were the differences between the TAR group and the No Instruction Control ($t[97] = 1.04$) and the SSTT ($t[97] = 1.54$) groups.

Figure 1 shows the quiz scores for each experimental group. The pattern of scores reflects the results of the analyses of adjusted scores, but are somewhat easier to understand intuitively. The group differences which are apparent in Figure 1, and which appeared as significant comparisons on the statistical analyses reported above, concern the performance of the SSTT group on Quiz 2 and Quiz 3. The SSTT group performs relatively well on Quiz 2. However, this difference is not maintained on Quiz 3; SSTT group performance is comparable to the other groups. This odd pattern of results suggests that we should examine carefully whether performance of the SSTT group is artifactually high on Quiz 2, or artifactually low on Quiz 3.

Exit Questionnaire Results

Data from exit questionnaires were obtained from the 32 subjects in the SSTT and TAR groups. The questionnaires assessed the impressions of the subjects regarding the SDMS, the instructional material, and the quizzes.

Fifteen questions assessed the subject's opinions regarding system components, specifically, the button box, joystick, color monitor, black and white monitor, study room, and computer materials. Answers to these questions were coded on a scale from 1 to 5, with 5 being the most favorable response. Where more than one question addressed a single component, a composite score for that component was calculated as the arithmetic average of the questions. The composite ratings for the system components are presented in Figure 2 for both the SSTT and TAR groups. The overall positive impression of the subjects is indicated by the fact that the mean rating for all system components is between 4.0 and 5.0. The color monitor and the joystick received the highest rating. It would be interesting to speculate whether these components are rated so favorably because of their widespread use in video games. The lowest rating was received by the button box. It is hypothesized that because of the multiple functions to which a button may be assigned depending on the context, it is more difficult to learn to use this system component.

Figure 1

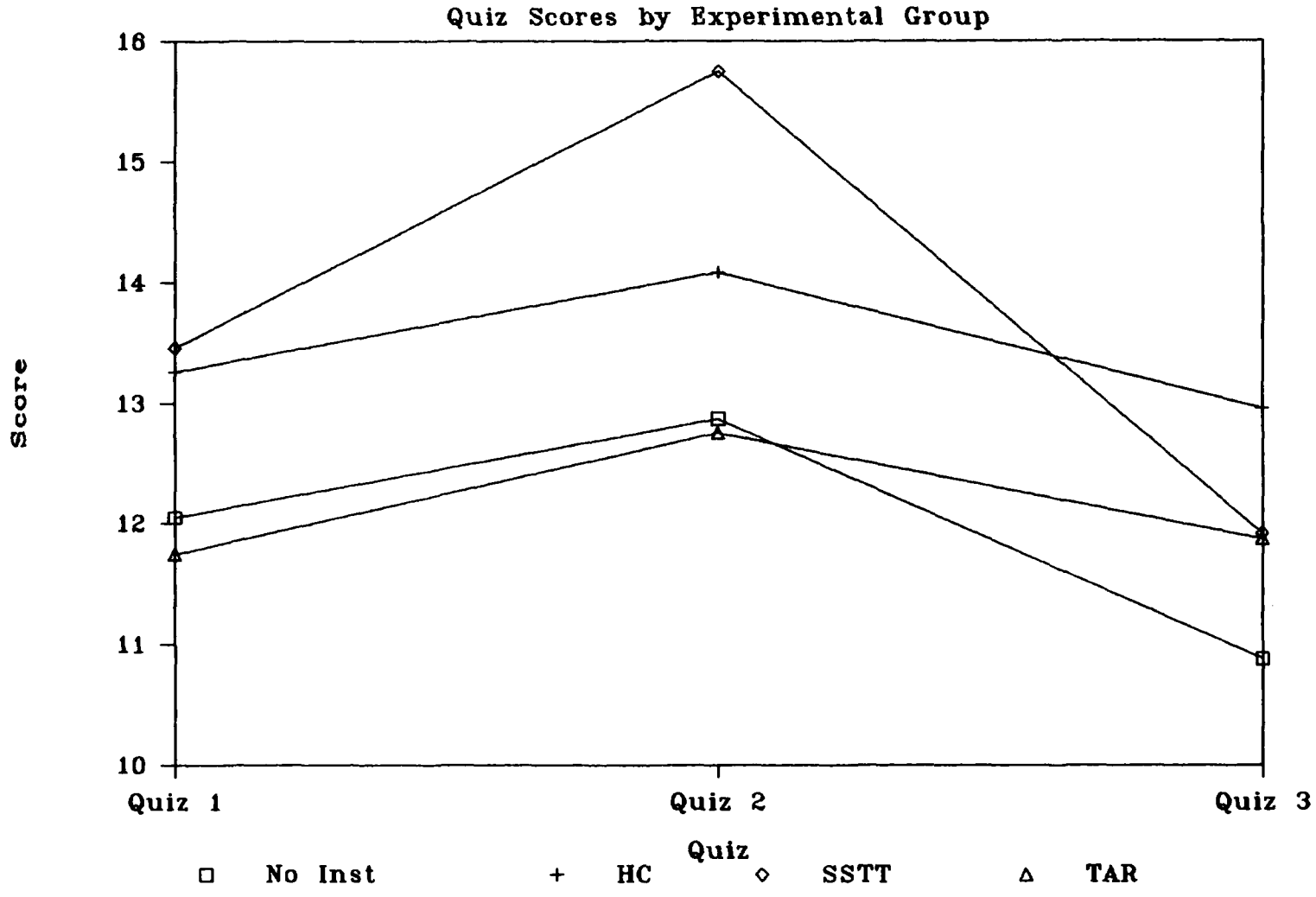
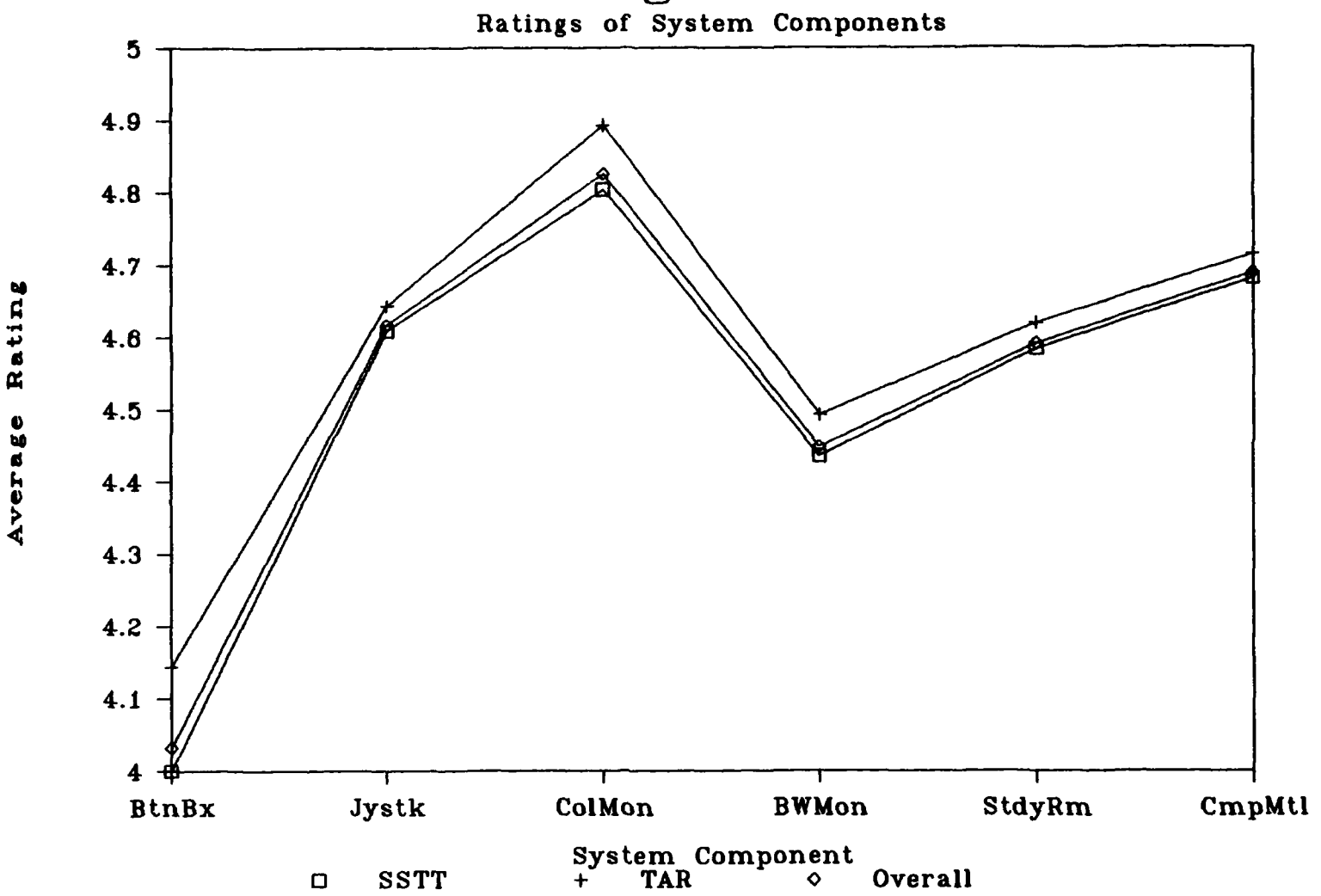

Quiz Scores by Experimental Group
16
15
14
13
12
11
10
Score
Quiz 1
Quiz 2
Quiz 3
Quiz
No Inst
HC
SSTT
TAR

Figure 2


Ratings of System Components
Average Rating
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
BtnBx
Jystk
ColMon
BWMon
StdyRm
CmpMtl
System Component
SSTT
TAR
Overall

As indicated on Figure 2, there are no substantial differences between groups on their ratings of the system components.

Each of the instructional segments was evaluated on nine attributes. The first five of these attributes relate to the techniques demonstrated in the instructional segments. Subjects assessed whether the techniques were realistic, meaningful to them, easy to understand, easy to imitate, and easy to apply during practice. The sixth question assessed whether the people who gave the demonstrations were like people the subject had known. The final three questions addressed the practice situations, assessing whether they were realistic, meaningful to the subjects, and useful to them.

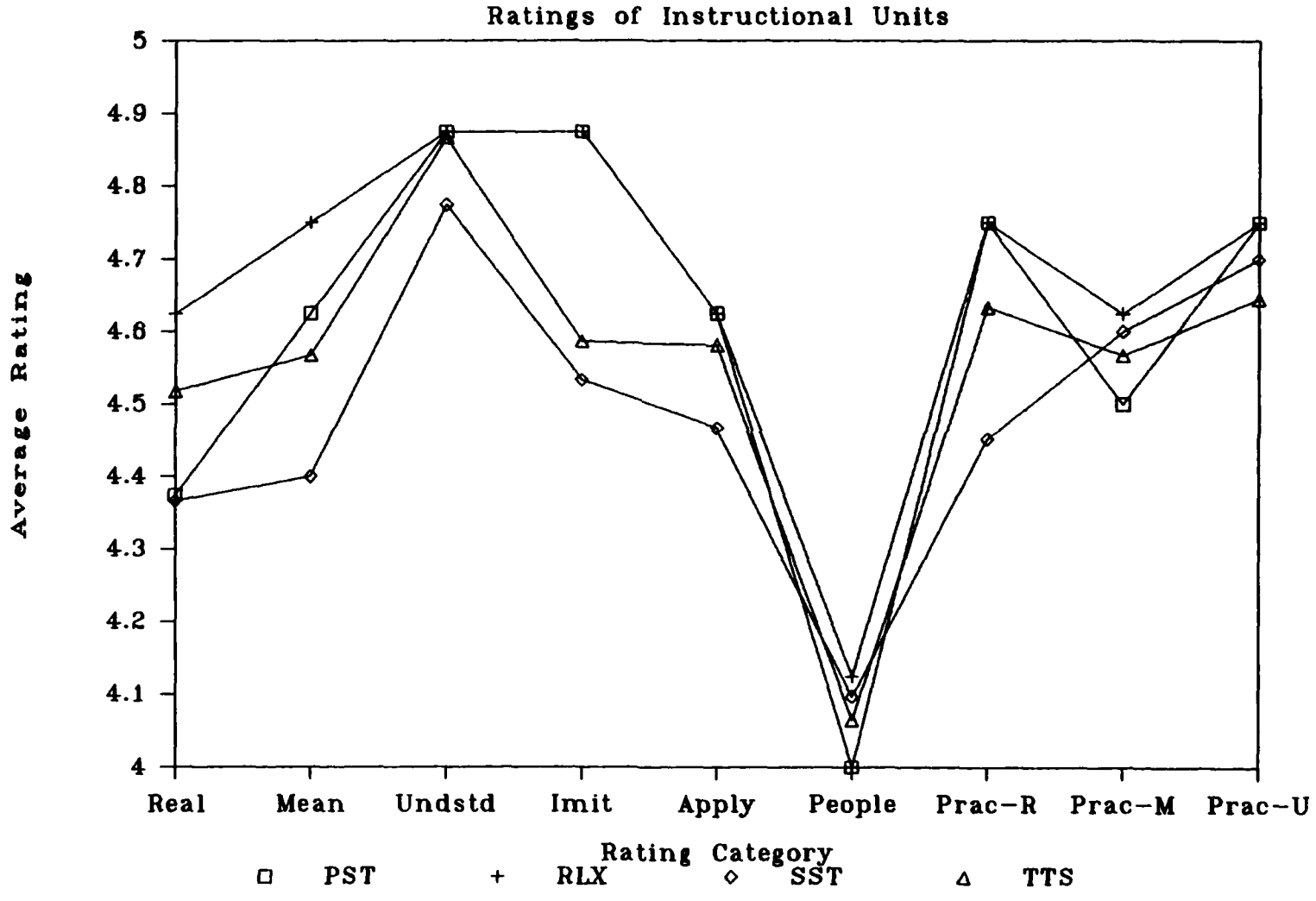
Responses to these questions were coded on a five-point scale. The average ratings for the instructional units are shown in Figure 3. As was the case for the system components, the ratings are generally very positive. The extent to which the people who gave the demonstrations were like people known to the subjects received the lowest rating for all four instructional units. There were some small differences in the ratings of the four tasks. For example, the two TAR units, positive self talk and relaxation techniques, were judged to be easier to imitate than the study skills and test-taking strategies units. Furthermore, these units were judged to have more realistic practice.

Overall, the questionnaire results unambiguously show a positive reaction of the subjects to both the training system and the training materials. Among system components, subjects are most favorable to the color monitor and joystick, and least favorable to the button box. In evaluating the instructional material, subjects gave uniformly positive responses in all areas except the familiarity of the characters in the demonstrations.

Discussion

The two most outstanding aspects of the results are the lack of any effect of TAR instruction and the anomolous effect of study-skills instruction. Regarding the former, it is not entirely surprising that TAR instruction should prove ineffective. First, the instruction lasted only three hours, and was conducted in a single day. Previous research by Anton and Bendell (cited in Spielberger et al., 1979) which did show beneficial effects of TAR instruction used eight hours of instruction occurring over a four-week period. Thus, the extent of instruction may not be sufficient to produce the desired effect. Second, the TAI assesses typical responses of the respondents to test situations. Because of the short time between the pre-and post-tests of the TAI,

Figure 3


Ratings of Instructional Units
Average Rating
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
Real
Mean
Undstd
Imit
Apply
People
Prac-R
Prac-M
Prac-U
Rating Category
PST
RLX
SST
TTS

it is likely that the subjects would have no experience with anxiety-producing test situations. Thus, even if the instruction had substantially decreased test anxiety, it is likely that this difference would not be detected by the TAI, because the subject did not have any recent examples by which he could judge has response to testing situations. Finally, the small number of soldiers who received TAR instruction makes it impossible to detect small or moderate differences in test anxiety between experimental groups.

The second result seems to indicate that although the study-skills instruction is effective, the study skills that are learned are quickly forgotten. If this is the case, then the instruction should be redesigned to maximize retention. Additional practice of the strategies should be conducted, and spacing of practice should be investigated. One possible way to provide spaced practice is to embed the learning strategies curriculum within content training. This suggestion corresponds to Weinstein's (1982) idea of a learning strategies metacurriculum. The success of such a training concept is currently unknown. Thus, further research is required to define an optimal design for training in learning strategies.

Experiment 2

In the second experiment, the effects of training in learning strategies were assessed in a field setting. This setting allows for more instruction to be presented to subjects (about 8 hr), but limits the amount of experimental control which can be maintained. Because the learning strategies are general across a wide range of tasks, it was hypothesized that the maximum effectiveness of the instruction would be obtained using general performance measures, such as SQT scores. Two types of control groups were used as comparisons in assessing the effectiveness of the learning strategies curriculum. The first control group received no instruction in learning strategies; only initial background and other entry data were collected for this group. A second control group received instruction using the SONS material. It was hypothesized that since this instruction concentrated on a set of skills with limited application, the effect of the instruction would not be noticeable in general measures, such as SQT scores.

Method

Subjects

Subjects were 175 (170 male and 5 female) soldiers enrolled in the BSEP II program at Ft. Stewart, GA. Two-thirds of the subjects were high school graduates (57.6%) or had a GED certificate (8.8%). Of the remaining subjects, 10.6% had attended college, while 22.9% had not completed high school. The experiment involved eight hours of participation, over a period of four consecutive days.

Experimental Groups

Subjects were placed in one of three groups. Subjects in the control group (C) received no training in either learning strategies or spatial orientation and navigational skills. Data for these subjects consist of demographic data and performance data obtained from Army records. Subjects in the learning strategy group (LS) received training in the learning strategy curriculum, including test-anxiety reduction, study skills, and test-taking strategies. Subjects in the Spatial Orientation and Navigational Skills group (SONS) received training in navigational skills, including presentations of information and interactive exercises covering direction facts, tips, and procedures.

Data

Each subject filled out a background questionnaire containing information about the subject's sex, Military Occupational Specialty (MOS), rank, service period, and educational level. In addition subjects filled out the TAI and the modified version of the SSHA developed for this research.

Subjects in the LS and SONS conditions filled out the TAI following their instruction. Post-TAI scores were used to ascertain the effectiveness of the instruction in test-anxiety reduction. In addition, subjects in these groups filled out an exit questionnaire assessing their opinions of the instructional system and methods.

Most of the dependent measures were obtained from Army records of the subjects. In obtaining these measures, we tried to obtain those scores for tests taken both before and after the experiment. However, both pre- and post-experimental scores were not available for some of the dependent measures. Dependent measures obtained from Army records include the TABE, the SQT, GT, and the Armed Services Vocational Aptitude Battery (ASVAB). Post-experimental GT scores and pre-experimental ASVAB scores were not available for any of the subjects.

Procedure

Subjects were given pre-experimental questionnaires in their classrooms. Available subjects were then assigned to the treatment conditions. No further information was collected for control subjects.

The training for the LS and SONS groups occurred in the Learning Center at Ft. Stewart, GA. Participation in the experiment required from six to eight hours, and was conducted over four consecutive days in two-hour blocks. Subjects in the LS and SONS groups received instructional material on learning strategies and spatial orientation skills, respectively, during this time. All material was presented using the SDMS based on an Apple II computer. The order in which subjects viewed instructional segments was under their control. However, instructional material for the SONS group was contained on three diskettes; subjects could only view the material on one of these diskettes at any time. When subjects had seen all of the material, they filled out an exit questionnaire, took the TAI, and their participation was completed.

Results

The general analytical approach involved performing analyses of covariance (ANCOVA) to detect group differences in the post-experimental dependent measures with the pre-experimental measures as covariates. However, because of the sparseness of the data for of the variables obtained from Army records, there were very few subjects for which both pre- and post-experimental measures existed, thus precluding the use of ANCOVA without drastically reducing the sample size. For variables in which insufficient pre-experimental data existed, group differences were determined using analysis of variance. Because the use of ANOVA presumes that there are no pre-experimental differences between groups, we examined the pre-experimental variables to determine whether any group differences existed. Then we analyzed the group differences on the post-experimental measures, using either ANOVA or ANCOVA, as appropriate. Finally, we examined the opinions of the subjects as expressed in the exit questionnaire.

Pre-experimental Group Differences

The analysis of scores on pre-experimental measures, shown in Table B-2, indicates that, with the exception of Test Anxiety, the experimental groups may be treated as equivalent. The average value of the test statistic over all variables is very close to 1.0, which is its expected value under the null hypothesis of no differences between groups. On the TAI, the LS group showed higher anxiety than the SONS and control groups on both the Worry and Emotionality subscales, although only the difference on the Worry subscale was significant. Hence, the initial differences between groups must be taken

into account in determining the effectiveness of instruction in test-anxiety reduction.

Table B-2
Means of Pre-experimental Measures by Experimental Group

Variable	Group Mean			F	d.f.
	Control	LS	SONS		
Rank	3.62	3.67	3.53	0.37	2,170
Months in Service	33.87	32.44	34.77	0.20	2,163
Education	3.56	3.57	3.51	0.07	2,167
TAI (Total)	38.51_{ab}	42.40_{a}	36.37_{b}	4.81*	2,165
TAI (Worry)	15.15_{a}	17.06_{b}	14.36_{a}	5.31*	2,165
TAI (Emotionality)	15.23	16.56	14.79	2.34	2,165
SSHA (Delay Avoidance)	16.92	15.70	15.73	0.30	2,165
SSHA (Work Methods)	19.32	16.27	18.58	1.93	2,165
SSHA (Study Habits)	35.11	31.97	34.20	0.57	2,165
TABE (Vocabulary)	9.16	8.50	8.34	1.85	2,162
TABE (Comprehension)	8.34	7.67	8.04	1.65	2,162
TABE (Verbal)	8.68	8.01	8.14	1.85	2,163
TABE (Computation)	7.44	7.07	7.19	0.61	2,165
TABE (C & PR)	7.48	7.36	7.43	0.07	2,165
TABE (Quantitative)	7.41	7.18	7.23	0.29	2,166
TABE (Language)	7.35	7.12	7.07	0.29	2,156
SQT	84.82	80.96	83.47	1.06	2,50
GT		86.20	82.88	1.64	1,36

Note. Means in the same row with different subscripts are significantly different by a Tukey test, $p < .05$.

* $p < .01$

Test Anxiety

Although all subjects received the pre-TAI, only subjects in the LS and SONS groups received the TAI a second time. For this reason, we cannot distinguish an improvement brought about by the instruction from a practice effect. However, we can use the SONS group as a control group to test the effectiveness of instruction specifically designed to reduce test anxiety, as it relates to instruction in an irrelevant area.

Test-anxiety, as measured by the TAI, was reduced for both experimental groups. For the LS group, this difference was 3.95 points ($t[66] = 3.02$, $p < .01$). Similar differences occured in both the Worry ($d = 1.17$, $t[66] = 1.9$, $.05 < p < .10$), and Emotionality subscales ($d = 1.68$, $t[66] = 2.49$,

$p < .05$), although the difference was not significant for the Worry subscale. The improvement was even greater for the SONS group. For the total score, the improvement was 5.26 points ($t[53] = 6.48$, $p < .01$). Improvements in the Worry ($d = 1.34$, $t[53] = 2.68$, $p < .01$) and Emotionality subscales ($d = 2.57$, $t[53] = 6.32$, $p < .01$) were also greater for the SONS group than for the LS group.

The apparent superiority of SONS training in reducing test anxiety was tested by comparing the post-TAI scores adjusted for pre-TAI scores using an ANCOVA. The results indicated a significant superiority of SONS training in both the TAI total ($F[1,116] = 8.77$, $p < .01$) and in the Emotionality subscale ($F[1,116] = 8.93$, $p < .01$). The difference was not significant for the Worry subscale ($F[1,116] = 3.11$, $.05 < p < .10$).

TABE Scores

Both pre- and post-TABE scores were available for a sufficient number of subjects to allow analysis using ANCOVA. The results of these analyses are shown in Table B-3. These results do not show any positive effect of either instructional program on TABE scores. In the Language subscale, which is the only scale for which the groups differed significantly, the control group had the greatest improvement from the pre- to post-experimental administrations of the TABE ($d = 4.92$). The degree of improvement was less for both the LS group ($d = 3.94$) and the SONS group ($d = 2.51$).

Table B-3
Results of ANCOVA on Post-TABE Scores

TABE Subscale	SS group	SS error	F	d.f.
Vocabulary	11.50	165.02	2.27	2,65
Comprehension	3.08	159.07	0.63	2,65
Verbal	2.86	106.69	0.87	2,65
Computation	0.44	315.90	0.05	2,76
C & PR	6.41	159.11	1.51	2,75
Quantitative	1.18	153.68	0.29	2,75
Language	26.34	89.20	5.46*	2,37

* $p < .01$

SQT and ASVAB Results

For the remaining dependent measures, there are very few subjects for which both pre- and post-experimental data were available. Consequently, we analyzed these data using ANOVA, rather than ANCOVA, as was the case for the TABE and TAI data. The mean SQT and ASVAB component scores are shown for each group in Table B-4. As Table B-4 indicates, the differences in performance between groups is very slight, and form no obvious pattern. The group differences are not significant for any of the measures. However, the results should be interpreted in light of the small number of subjects from whom data were available.

Table B-4
Means of Post-experimental SQT and ASVAB Component Scores

Variable	Group Mean			F	d.f.
	Control	LS	SONS		
SQT	63.62	63.78	69.53	0.86	2,47
ASVAB (GT)	105.00	101.67	103.50	0.26	2,28
ASVAB (GM)	85.60	85.33	89.33	0.27	2,28
ASVAB (EL)	96.70	99.00	97.83	0.13	2,28
ASVAB (CL)	105.60	108.20	107.67	0.11	2,28
ASVAB (MM)	96.10	99.20	100.50	0.35	2,28
ASVAB (SC)	96.70	95.40	94.50	0.06	2,28
ASVAB (CO)	86.40	90.07	91.33	0.22	2,28
ASVAB (FA)	97.10	102.13	97.17	0.98	2,28
ASVAB (OF)	95.30	96.13	105.00	0.97	2,28
ASVAB (ST)	91.10	94.53	88.00	0.97	2,28

Exit Questionnaire Results

Data from the exit questionnaires were obtained from the subjects in the LS and SONS groups. The exit questionnaires assessed the students' responses to both system components and instructional segments.

The subjects' opinions regarding system components were assessed with fifteen questions for the LS group and sixteen questions for the SONS group. System components addressed by these questions were the button box, joystick, color monitor, black and white monitor, study room, and computer materials. The extra question for the SONS group reflects the fact that the joystick was used to produce movement in surrogate travel exercises; these exercises were given to the SONS group only. Answers to these questions were coded on a scale from 1 to 5, with 5 being the most favorable response. Where more than one question addressed a single component, a composite

score for that component was calculated as the arithmetic average of the questions. The composite ratings for the system components are presented in Figure 4.

The results for the two groups are very similar. Subjects' responses were very favorable to all system components, as reflected by the fact that average ratings were all above 3.9 on the 5-point scale. The color monitor and joystick received particularly high ratings among the hardware components, corresponding to earlier evaluations of both LS and SONS material. The button box received the lowest rating, possibly because of the multiple functions which it must serve depending on the context.

The LS group rated each of the four major components of the instruction on nine attributes. The first five of these attributes assessed whether the techniques demonstrated in the instruction were realistic, meaningful to the subjects, easy to understand, easy to imitate, and easy to apply during practice. The sixth question assessed whether the people who gave the demonstrations were like people the subject had known. The final three questions addressed the practice situations, assessing whether they were realistic, meaningful to the subjects, and useful to them.

Responses to these questions were coded on a five-point scale. The average ratings for each instructional unit are shown in Figure 5. Again, the results show a uniformly positive reaction to the instruction. The extent to which the people who gave the demonstrations were like people known to the subjects received the lowest rating in all four instructional units. There were essentially no differences among the ratings given to different units.

Subjects in the SONS group rated each section of the instruction according to how much they liked it. In addition, the difficulty of the exercises was rated. Enjoyability was coded on a five-point scale in which 5 represented the greatest enjoyability. Difficulty was rated on a four-point scale in which the score of 4 represented the greatest difficulty. The average enjoyability and difficulty ratings are shown in Table B-5.

Figure 4

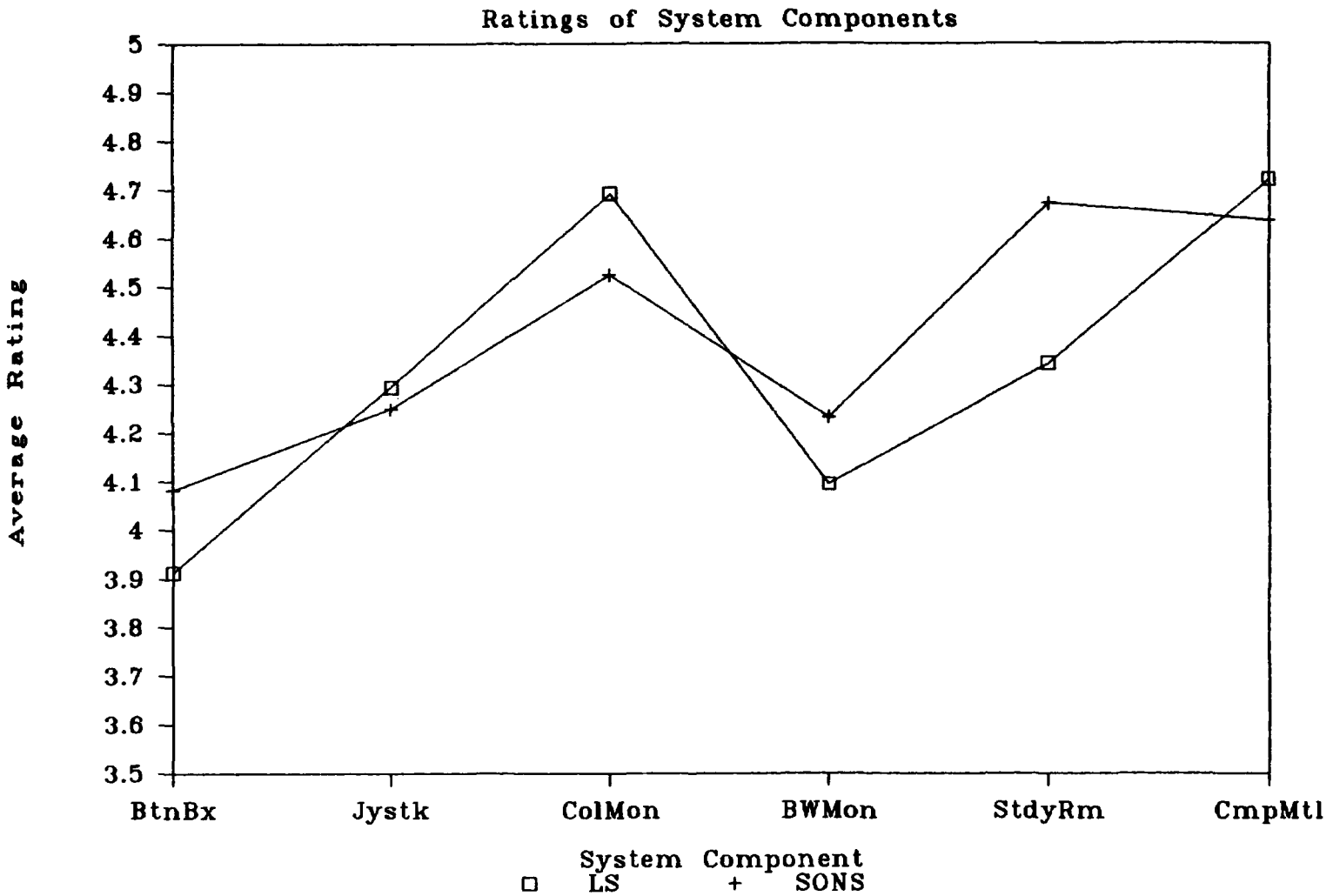

Ratings of System Components
Average Rating
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
BtnBx
Jystk
ColMon
BWMon
StdyRm
CmpMtl
System Component
LS
SONS

Figure 5

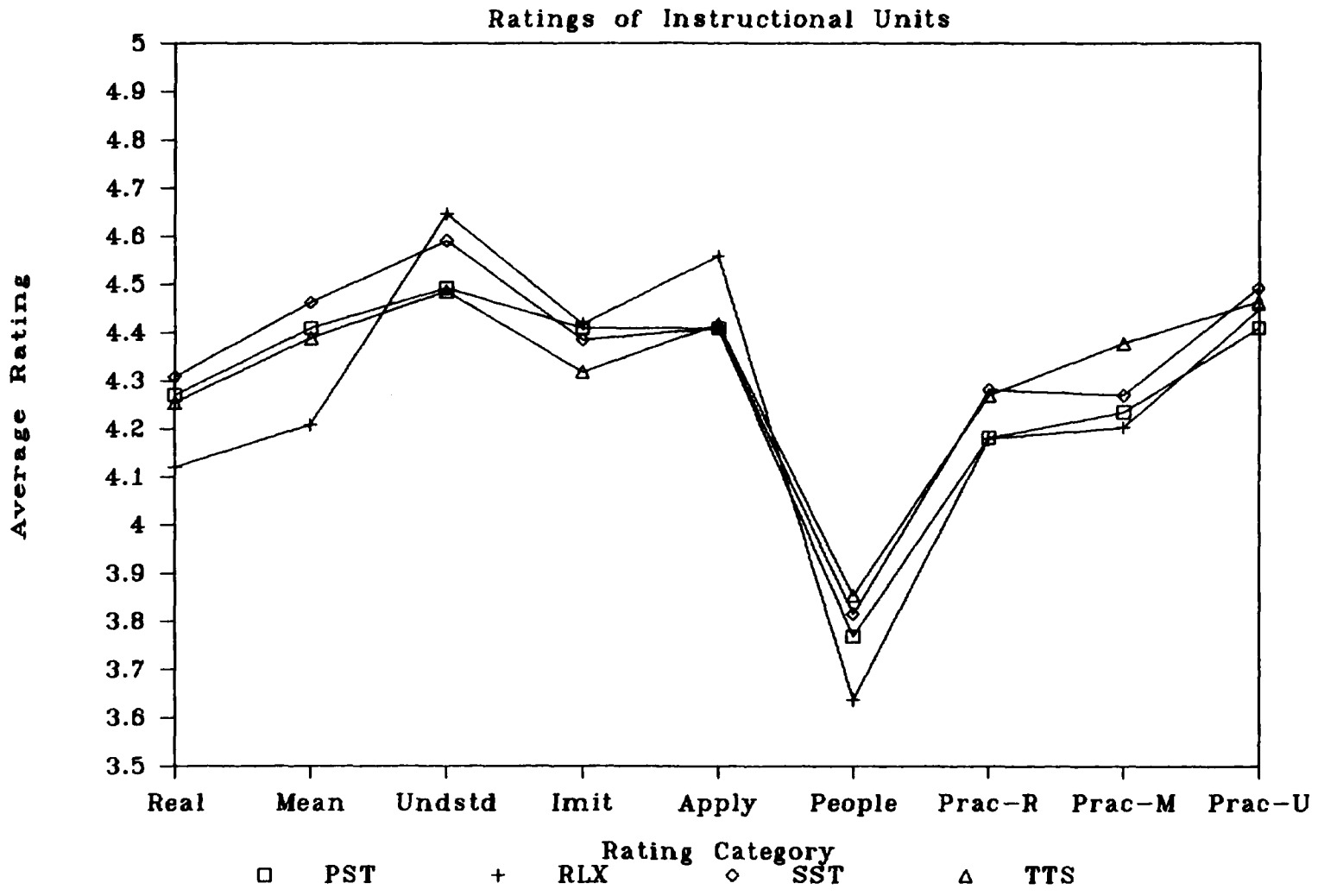

Ratings of Instructional Units
Average Rating
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
Real
Mean
Undstd
Imit
Apply
People
Prac-R
Prac-M
Prac-U
Rating Category
PST
RLX
SST
TTS

Table B-5
Mean Enjoyability and Difficulty Ratings of SONS Material

Unit	Enjoyability	Difficulty
"Kidnapped" Exercise	4.07	
"Tied to the Track"	4.20	1.98*
Left-Right (Ball)	3.74	
Left-Right (Car)	3.97	
Left-Right (Person)	3.96	
Compass Headings	4.09	
Directions in a Room	3.86	
Sun/Shadows	4.07	
Use of Landmarks	4.05	
"Follow that Car" Game	4.39	1.84
Minefield Game	4.41	1.95
Memory Trips	4.46	2.05
Test Yourself Tasks	4.16	2.00
Angle Pool Game	4.55	
Tank War Game	4.30	2.62
Map Skills	4.17	2.51

*This rating assessed the difficulty of both dramatic travel exercises.

Enjoyability was high for all instructional segments. However, enjoyability is greater for the exercises and games than for the instructional segments. The average difficulty corresponded to the response "Fairly Easy." The Tank War Game and the Map Skills Exercise were rated somewhat more difficult than the other games and exercises.

Discussion

The major results of Experiment 2 involve the reduction in test anxiety for both the LS and SONS groups, and the lack of differences between the groups on any of the general performance measures. The effectiveness of the instruction in reducing test anxiety must be interpreted in light of the fact that a post-experimental TAI was not given to the control group. The control group in Experiment 1 showed an improvement of approximately 5 points on the TAI; this value is comparable to the improvement that occurred in both the LS and SONS groups in Experiment 2. Thus, there is reason to believe that much of the reduction in test anxiety is artifactual. The surprising result, however, is that the SONS instruction was more effective in reducing test anxiety than the LS instruction which included specific instruction in test-anxiety reduction. These results must be interpreted carefully, because there are pre-experimental differences between the groups. However, as the direction of the post-

experimental differences is the opposite as the predictions of a regression effect, these results bear closer examination.

A number of conjectures may be made regarding this finding. The SONS training presents information an a very informal manner, relying to a great extent on games and exercises. Thus, the instructional material presents information in a way that would tend to produce low levels of anxiety. This style of information may serve to desensitize the subjects to the anxiety-producing situations that are often involved with instruction. The LS instruction, on the other hand presents anxiety-arousing situations in order to give the subjects practice in performing anxiety-reducing techniques. These situations instruction may themselves produce too much anxiety to be effective for desinsitization to occur, especially for the relatively test-anxious subjects in the LS group.

Perhaps the most disappointing aspect of the results is the lack of any differences between the groups on any of the performance measures. However, this result should not be particularly surprising in light of a long history of research in learning and memory. These results suggest that we would expect instruction to have the greatest effect on performance on tasks that are similar to the specific tasks that are trained, and are measured as closely as possible to the time of the instruction. The results of Experiment 1 support these general findings, and indicate that the study skills component of the LS training is forgotten very quickly. However, the dependent measures in this experiment were both very different from the initial instruction, and they were given months after the instruction was completed. It seems unreasonable to expect that eight hours of training in learning strategies would have a noticeable effect on a soldier's performance on an SQT test given weeks or months after the training was completed.

The responses to the exit questionnaire in Experiment 2 closely parallel those in Experiment 1. These results indicate that the unique aspects of videodisc training, that is, the ability to present interactive movies, are viewed by the subjects as the most positive aspect of the training system. In addition, the spatial organization of information accessed using a joystick, the defining characteristic of SDMS, was also rated quite positively. Thus, in terms of subjective response, the system seems to be providing an appropriate interface with the students. Whether other instructional material might be more effective when presented on SDMS remains a question for future research.

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ANNEX A

TEST OF SELECTED MILITARY KNOWLEDGE

TEST OF SELECTED MILITARY KNOWLEDGE

DIRECTIONS: Each of the following multiple-choice questions has three, four or five answer choices marked A, B, C, D or E. On the answer sheet blacken the circle which corresponds to the answer you think is correct.

As you answer each question make sure that the number on the answer sheet is the same as the number of the question you are working on.

Some questions have only four answer choices; for these do not use answer "E" on the answer sheet.

Some questions have only three answer choices; for these do not use answers "D" or "E" on the answer sheet.

There is no penalty for wrong answers so try not to leave any questions blank.

You will have 18 minutes to complete the test.

DO NOT OPEN THE TEST BOOKLET TILL TOU ARE TOLD TO DO SO.

TEST OF SELECTED
MILITARY KNOWLEDGE

General Situation: You are attempting to revive a drowning casualty who appears lifeless.

1. What procedure should be used first for reviving the casualty?
   A. If possible start the mouth-to-mouth method of artificial respiration before the casualty is brought ashore
   B. Get the casualty ashore and immediately begin artificial respiration
   C. Get the casualty ashore and immediately strike the chest with your fist in an effort to restart breathing
   D. Get the casualty ashore and turn him in an attempt to drain water from his lungs

General Situation: Your combat unit has been operating in North Africa. Your commander has told you to brief a group of replacements on first aid measures to be taken for bites of local poisonous snakes, spiders and stings of scorpions.

2. In which of the positions below should you place a person who has been bitten by a poisonous snake?
   A. Lying position
   B. Standing position
   C. Sitting position
   D. Kneeling position

General Situation: You have the need to administer atropine.

3. Where are automatic atropine injectors normally carried?
   A. The upper outer pocket of your field protective mask carrier
   B. Your first aid kit
   C. The upper inner pocket of your field protective mask carrier
   D. The breast pocket of your field jacket or fatigue shirt
   E. None of the above

General Situation: Your squad has been travelling by foot for 9 hours through an extremely hot region. You suspect that the heat has affected one of your squad members.

4. Which symptom below is not characteristic of heat exhaustion?
   A. Muscle cramps
   B. Weakness
   C. Dizziness
   D. Stoppage of sweating

General Situation: You are in a combat area in which chemical agents are present. You have with you appropriate decontamination and reimpregnating kits and detectors and defensive items.

5. Which item below is included in the ABC-M-13 Individual Decontamination and Reimpregnating Kit?
   A. Single-edge cutter
   B. Nerve agent antidote injectors
   C. Dosimeter
   D. First Aid Kit

General Situation: You are in a combat area in which chemical agents are present. You have just put on the Standard-A Chemical Protective Overgarment ensemble.

6. Which statement below is most correct concerning the Standard-A Chemical Protective Overgarment ensemble?
   A. It is expendable and is discarded within one week after being contaminated with liquid chemical agents or when it becomes worn or ripped
   B. It is reuseable and should be laundered or decontaminated within 24 hours after being contaminated with liquid chemical agents
   C. It is expendable and is discarded within 24 hours after being contaminated with liquid chemical agents or when it becomes worn or ripped
   D. It is expendable and is discarded within 6 hours after being contaminated with liquid chemical agents or when it becomes worn or ripped
   E. It is reuseable and should be laundered or decontaminated within 6 hours after being contaminated with liquid chemical agents

General Situation: Your unit has been transferred to a cold, wet environment. You have been told to learn the symptoms and treatment for trench foot, immersion foot, frostbite, and snow blindness.

7. What first aid measure would you try first for frostbite involving only the skin?
   A. Soak the frostbitten member in cold water
   B. Rub the frostbitten member with snow
   C. Massage the frostbitten member
   D. Warm the frostbitten member in front of an open fire
   E. None of the above

General Situation: You are in a combat area in which chemical agents are present. You have just put on the M-17 series chemical, biological field protective mask.

8. Which item below is not carried in the CB Protective Mask Carrier?
   A. M-13 decontaminating and reimpregnating kit
   B. A book of chemical agent detector paper
   C. Nerve agent antidote injectors
   D. First Aid Kit
   E. Amyl nitrite ampuls

General Situation: You are in a field situation and have just cut yourself while opening your C-rations.

9. What is the principal danger involved with a small wound?
   A. Excessive bleeding
   B. Infection from contamination
   C. Interference with the operation of equipment

General Situation: Your buddy has stopped breathing. You need to administer artificial respiration. You are in a toxic environment.

10. Which of the following statements is correct if you are forced to give artificial respiration in a toxic environment?
   A. Both you and the casualty wear your M17A1 Field Protective Masks
   B. Neither you nor the casualty wear your M17A1 Field Protective Mask
   C. You wear your M17A1 Field Protective Mask but the casualty does not wear a mask

General Situation: You have been exposed to a cyanide blood agent.

11. What is the recommended first aid measure?
   A. Inhalation of amly nitrite and administration of artificial respiration
   B. Injection of amyl nitrite and administration of artificial respiration
   C. Injection of atropine and administration of artificial respiration
   D. Inhalation of atropine and administration of artificial respiration
   E. None of the above

General Situation: The enemy is moving under cover of smoke. The smoke is reaching your location.

12. What action should you take if you are in a smoke cloud of Titanium Tetrachloride (FM) smoke?
   A. No action is required
   B. Flush any liquid FM from the skin with water
   C. Immediately give yourself an injection of atropine
   D. Use the skin decontaminating pad to absorb any liquid FM

ANNEX B

STUDY MATERIAL AND QUIZZES ON MILITARY TOPICS

TOPIC ONE STUDY MATERIAL

ADMINISTER FIRST AID IN A TOXIC ENVIRONMENT

SOLDIER'S NOTICE

SKILL COMPONENT (SC)

-- Description

- o TESTS 1 TASK
- o 20 QUESTIONS ON TASK
- o ALL QUESTIONS ARE MULTIPLE CHOICE WITH 3 to 5 POSSIBLE CHOICES

SC Test 1: Administer first Aid in a Toxic Environment (888-777-6666)

*You must pass 16 of the 20 questions to score GO

*SMPM 1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 15, and 18

888-777-6666

ADMINISTER FIRST AID IN A TOXIC ENVIRONMENT

CONDITIONS

Given: Field Protective Mask M17A1, automatic atropine injectors, and M13 Individual Decontaminating and Reimpregnating Kit.

STANDARDS

Correctly perform Mask-to-Mouth artificial respiration.

Correctly identify the primary physiological effects produced for common chemical agents used for warfare and identify the first aid measure to be taken for each.

PERFORMANCE STANDARDS

1. Identify first aid equipment issued for protection against concentrations of chemical and biological agents.
2. Know the protection provided by your M17A1 Field Protective Mask
3. Know what actions to be taken if you suspect mustard agent droplets in your eyes
4. Know the symptoms of nerve agent poisoning and the actions to be taken if the symptoms occur
5. Know the symptoms of atropine poisoning
6. Know the procedures for preparation of the protective mask for Mask-to-Mouth artificial respiration
7. Identify the chemicals classified as blister agents
8. Understand the first aid Measures for blister agent poisoning
9. Identify the chemicals classified as choking agents
10. Understand the first aid measure for choking agents poisoning
11. Identify the chemicals classified as blood agents
12. Understand the first aid measures for blood agent poisoning
13. Identify the chemicals classified as tear agents
14. Understand the first aid measures for tear agent poisoning
15. Identify the chemicals classified as vomiting agents
16. Understand the first aid measures for vomiting agent poisoning
17. Understand the characteristics and first aid measures to be taken for incapacitating agents

18. Identify the types of screening smokes that may be encountered and the first aid action to be taken

19. Identify the types of incendiaries that may be encountered in a toxic environment.

REFERENCES

FM 21-11 (Chapter 6)

CHAPTER 6

FIRST AID IN A TOXIC ENVIRONMENT

49. General

a. Gasoline, chlorine, and pesticides are examples of common toxic substances. They may exist in the physical state as a solid, liquid, or gas, depending upon temperature and pressure. Gasoline, for example, is a vaporizable liquid; chlorine is a gas; and DDT, a pesticide, is a solid. Some substances are more injurious to the body than others when they are inhaled, are eaten, or come in contact with body surfaces. Whether they are solids, liquids, or gases (vapors and aerosols included), they may irritate, inflame, burn, freeze, or destroy tissue such as that associated with the respiratory tract or the eyes. They may also be absorbed into the blood stream, thus causing disturbance to any one of the body's major functions.

b. You may come in contact with toxic substances in everyday use such as the use of disinfectants and of bleach solutions for cleaning clothes, through accidents in handling chemicals, or through exposure to chemical agents used as a means of warfare. Ordinarily, exposure to a toxic substance would be for only a period of minutes; however in warfare any toxic substance employed by the enemy would be such that it could persist for hours or days. This would produce a toxic environment in which you would have to live. You must, therefore, be prepared to protect yourself and others against the injurious effects of these agents and to give first aid, when necessary, within this toxic environment.

50. Protective and First Aid Equipment

You are issued equipment for protection against field concentrations of chemical and biological agents. Such equipment includes the field protective mask, automatic atropine injectors, and absorptive powder for decontamination of your skin and clothing. You must know when and how to use these items. When considered necessary, you will also be issued special protective clothing, "dubbing" for boots (vesicant agent resistant leather dressing), and other prophylactic and/or first aid drugs as required.

a. Field Protective Mask (Model ABC–M17 or M17A1). Your field protective mask is a *most important* piece of protective equipment. You are given special training in its use and care. If you are equipped with the M17A1 protective mask, see paragraph 25*b*(2)(*c*) for explanation of the drinking tube and the protective canteen cap.

b. Automatic Atropine Injectors. You are issued for your own use three automatic atropine injectors, each containing 2 milligrams of the drug. The injectors are individually sealed in plastic. They are to be carried in the upper outer pocket of your field protective mask carrier.

c. M13 Individual Decontaminating and Reimpregnating Kit. This kit which is effective against chemical agents consists of—

(1) One skin decontaminating pad for use in absorbing droplets of chemical agents from your skin. It is a continuous belt-type pad designed to fit over your gloved fingers.

(2) Two bags, each containing chloramide powder and a dye capsule for use in neutralizing and indicating droplets of liquid chemical agents on your clothing and personal equipment as described in FM 21–41.

(3) A cutter to remove from your clothing the contaminated areas indicated by the dye ((2) above).

Note. The contents of this kit should NOT be used in or around the eyes. Only water should be used to flush chemical agents from the eyes.

51. Protective and First Aid Measures for Chemical-Biological Agents

a. General.

(1) Chemical agents for warfare uses may be classified according to the primary physiological effects they produce, such as nerve, blister, blood, choking, vomiting, and tear (lacrimators) agents. Your field protective mask gives protection against chemical agents as well as biological agents and the breathing in of radioactive particles. By means of previous practice, you should be able to mask in 9 seconds or less.

(2) Ingesting water or food contaminated with nerve, blister, and other chemical agents and some biological agents can be fatal. Never consume water or food which could have become contaminated until it has been tested and found safe for consumption.

b. Conditions For Masking Without Order Or Alarm. Once an attack with a chemical or biological agent is detected or suspected

or information is available that such an agent is about to be used, you must mask immediately and not wait to receive an order or alarm when—

(1) Your position is hit by—

(*a*) Artillery or mortor fire.

(*b*) Missiles or rockets.

(*c*) Smoke or mists.

(*d*) Aerial spray or bombs.

(2) Smoke from an unknown source is present.

(3) A suspicious odor, liquid, or solid is present.

(4) You are entering an area suspected of being contaminated.

(5) You have one or more of the following symptoms:

(*a*) An unexplained runny nose.

(*b*) A feeling of choking or tightness in the chest or throat.

(*c*) Dimming of vision.

(*d*) Irritation of the eyes.

(*e*) Difficulty in or increased rates of breathing without obvious reasons.

c. First Aid Steps For A Chemical Attack.

(1) *Step ONE.* Stop breathing, put on your mask and clear it, give the alarm, and continue mission.

Note. Keep your mask on until it has been determined that the area is no longer hazardous and you are told to unmask.

(2) *Step TWO.* If symptoms of nerve agent poisoning (para 52*b*) appear, give yourself an atropine injection (para 52*c*).

Note. Do NOT inject atropine until you are sure that it is needed.

(3) *Step THREE.* If you suspect chemical agent droplets in your eyes, accomplish the following actions as rapidly as possible. To be effective against mustard agents (para 53), they must be accomplished within 2 minutes.

(*a*) Unscrew the cap on your canteen.

(*b*) Remove your helmet.

(*c*) Take and hold a deep breath and raise your mask so that your face is uncovered.

(*d*) To flush your right eye, tilt your head back and slightly to the right. To flush your left eye, tilt your head back and slightly to the left.

(*e*) With your eyes looking upward, pour water into your

eye slowly, if possible, so that the water will not run onto your face and clothing. If you cannot keep your eye open, pull your eyelids away from your eye with your fingers.

(*f*) Reseat and clear your mask.

(4) *Step FOUR.* If you suspect that your face is contaminated, accomplish the following actions:

(*a*) Take your M13 kit (para 50*c*) from your protective mask carrier and open it.

(*b*) Take the skin decontaminating pad from the M13 kit and insert it over your gloved fingers.

(*c*) Take and hold a deep breath and raise your mask so that your face is uncovered.

(*d*) Blot the liquid contamination from your face with the skin decontaminating pad.

(*e*) Rotate the skin decontaminating pad and slap it on your face to release the powder; then rub the powder over the contaminated areas of your face. Do NOT get the powder in your eyes.

(*f*) If you suspect that a chemical agent is inside your mask, use the skin decontaminating pad to decontaminate the inside, applying the same techniques described in *d* and *e* above.

(*g*) Reseat and clear your mask.

(5) *Step FIVE.* As soon as your mission permits, remove any liquid contamination from other skin areas with the skin decontaminating pad from your M13 kit, using the same technique described in (4)(*d*) and (*e*) above.

(6) *Step SIX.* If nerve agents are used and your mission permits, be on the lookout for persons who need additional atropine injections and administer them.

(7) *Step SEVEN.* When your mission permits, decontaminate your personal clothing and equipment, using the bags of chloramide powder and cutter from your M13 kit as described in FM 21–41.

52. Nerve Agents

a. General. Nerve agents may enter the body through the eyes and the skin and by breathing and eating. Although the nerve agents can be absorbed into the body through unbroken skin, they do not produce a localized irritant effect. Smoking is not permitted for at least 24 hours after exposure to a nerve agent, as the tars and nicotine will increase and prolong the nerve agent effects.

b. Symptoms of Nerve Agent Poisoning.

(1) An unexplained runny nose.

(2) Marked difficulty in breathing with tightness in the chest.

(3) Possibly, pinpointed pupils of the eyes.

Note. Upon exposure to vapor or aerosol, the pupils become pinpointed immediately. However, if the nerve agent is only absorbed through the skin or by consuming contaminated food or water, the pinpointing does not occur immediately and may be absent.

(4) Drooling, excessive sweating, nausea, vomiting, cramping, and involuntary urination and defecation.

(5) Jerking, twitching, and staggering.

(6) Headache, confusion, drowsiness, coma, convulsions.

(7) Stoppage of breathing.

Note. If a casualty has the symptoms listed in (4) through (7) above, he probably will not be able to help himself, as they indicate severe poisoning.

c. First Aid Measures for Nerve Agent Poisoning.

(1) Administer atropine. If any of the symptoms of nerve agent poisoning (*b*) above are present, give yourself atropine, using one of your automatic atropine injectors (para 50*b*). This is accomplished as step TWO (para 51*c*(2)). If symptoms persist after 10 to 15 minutes, administer the second injection. If symptoms persist 10 to 15 minutes after the second injection, administer the third injection. If other soldiers are unable to give themselves atropine, inject it for them, using the automatic injectors from their protective mask carriers. Attach each empty injector to the outer clothing to indicate the number of injections received. This can be done by inserting the needle through the clothing and bending it to form a hook.

(*a*) An automatic atropine injector (fig 103) is used as follows:

1. After taking an automatic atropine injector from your protective mask carrier, remove its plastic cover.

Note. By NATO agreement the yellow band circling the self-injection device indicates atropine.

2. Hold the injector in your clenched hand with the yellow safety cap extending above the thumb (a, fig 103).

3. Remove the yellow safety cap by pulling it out (a, fig 103). The automatic injector is now "armed" and ready to use. Do NOT touch the green functioning end until you are ready to give the injection.

4. Place the green end of the injector against the clothing on the outside front thick muscle (thigh) (b, fig 103). Do NOT take time to remove clothing or to expose skin. If you need atropine, *speed is important.*

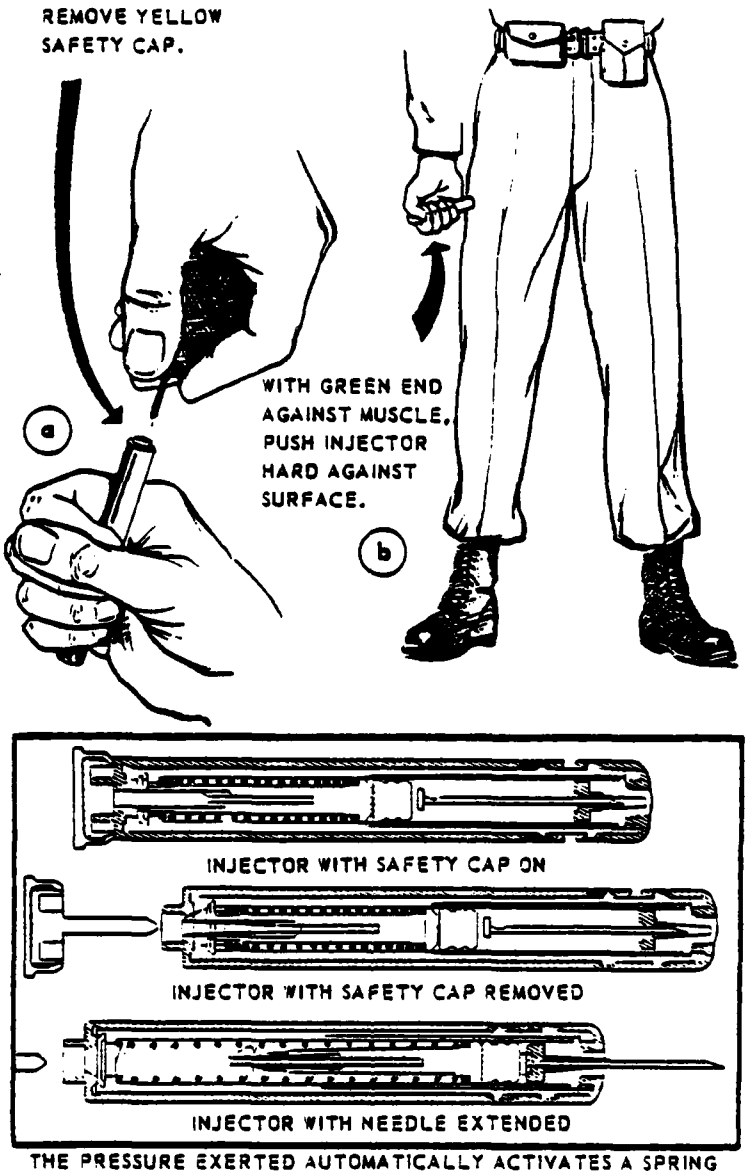


Figure 108. Use of atropine automatic injector.

5. Holding the injector perpendicular to the site, push it hard against the surface, thus automatically injecting the atropine.

6. Wait 5 seconds; then remove the needle from the skin with a quick pull. The 5 seconds are necessary for complete injection.

(*b*) If the atropine causes your breathing to become free and easy again, you may resume the performance of your duties. Dryness of the mouth is a good sign. This means that the atropine has overcome the dangerous effects of the nerve agent. Atropine does not necessarily relieve all of the muscular twitching nor does it relieve the effects of nerve agent vapors in the eyes. Such signs as hurting of the eyes, difficulty in focusing the vision on close objects, and headaches are annoying but are not dangerous.

Note. If atropine is injected without exposure to a nerve agent, toxic effects will become apparent.

The symptoms of atropine poisoning are described as follows: The casualty's skin appears flushed; he may have a rash on his face, neck, and upper trunk. He complains of being hot, dryness of the mouth, and difficulty in swallowing. In hot climates he may become a heatstroke victim (para 40*b*) unless evaporative cooling is provided. He may have a mental disturbance marked by delusions. Other symptoms are dilated pupils and blurred vision. Should a soldier take atropine without exposure to a nerve agent, obtain medical treatment for him as soon as possible.

(2) Administer artificial respiration, if needed. If your mission permits, look around and see if anyone needs your assistance. If a soldier's breathing has become faint or has stopped, administer artificial respiration. If he has not received an initial injection of atropine ((1) above), give it first; then start artificial respiration immediately. In a toxic environment a casualty must be given artificial respiration by either the mask-to-mouth method (*d* below) or the chest-pressure arm-lift method (para 8*c*).

d. Mask-to-Mouth Method of Artificial Respiration. The mask-to-mouth method of artificial respiration is a modification of the mouth-to-mouth method (para 8*b*). The objective is to get uncontaminated air into the casualty's lungs through the use of your M17A1 Field Protective Mask and M1 Resuscitation Tube. The mask-to-mouth method is performed as follows:

(1) Prepare your mask (a, fig 104) for administering artificial respiration:

(*a*) Turn the valve handle (b, fig 104) to the *left*, thus positioning the breathing tube bitepiece (inside the mask) between your teeth.

Note. The breathing tube bitepiece will spring back to the neutral position if you release your bite.

(*b*) Using your left hand, raise the voicemitter cover (a, fig 104); then with your right hand insert the outlet valve of the resuscitation tube (c, fig 104) into the air outlet well which is under the voicemitter cover. To obtain a tight, leakproof seal, first insert the unflanged edge of the air outlet valve (c, fig 104) with an upward push and then press the flanged edge inward as hard as possible.

(*c*) To determine whether or not a leakproof seal has been obtained, fold back and pinch the lower end of the corrugated tube (c, fig 104) and blow into your breathing tube bitepiece. If the corrugated tube does not tend to expand, remove and reinsert the outlet valve as explained in (*b*) above; then check again.

(2) Raise the casualty's protective mask only enough to expose his mouth and nose; then clear his airway (para 7).

(3) Position the casualty on his back, his head in a chin-up position, and his jaw in a jutting-out position as described for mouth-to-mouth (nose) method (para 8*b* (2)–(4)).

(4) Insert and secure the mouthpiece of the resuscitation tube (c, fig 104) between the casualty's lips and teeth (fig 105):

(*a*) To insert the mouthpiece between the casualty's lips and teeth, slide only one-half of it into his mouth at a time. Insert the indented portion of the mouthpiece under the upper lip. Insure that the edges of the mouthpiece are completely sealed with the casualty's lips.

(*b*) Secure the mouthpiece in place by forming a seal over the casualty's lips with your thumb and index finger. Hook the other three fingers under the casualty's chin to keep his jaw in a jutting-out position.

(5) Administer artificial respiration (fig 105):

(*a*) With your free hand, pinch the casualty's nose closed, take a deep breath, and blow into your breathing tube bitepiece ((1)(*a*) above).

(*b*) Continue blowing while watching for the casualty's chest to rise. If his chest does not rise, hold his chin up more forcefully and blow harder. If his chest still does not rise, check all connections for leakage of air.

(*c*) When the casualty's chest rises, stop blowing and release his nose, thus allowing him to exhale. Be sure to close his nose again as soon as he exhales.

(*d*) Continue blowing breaths into the casualty and allowing him to exhale. The first five breaths should be deep and fast to

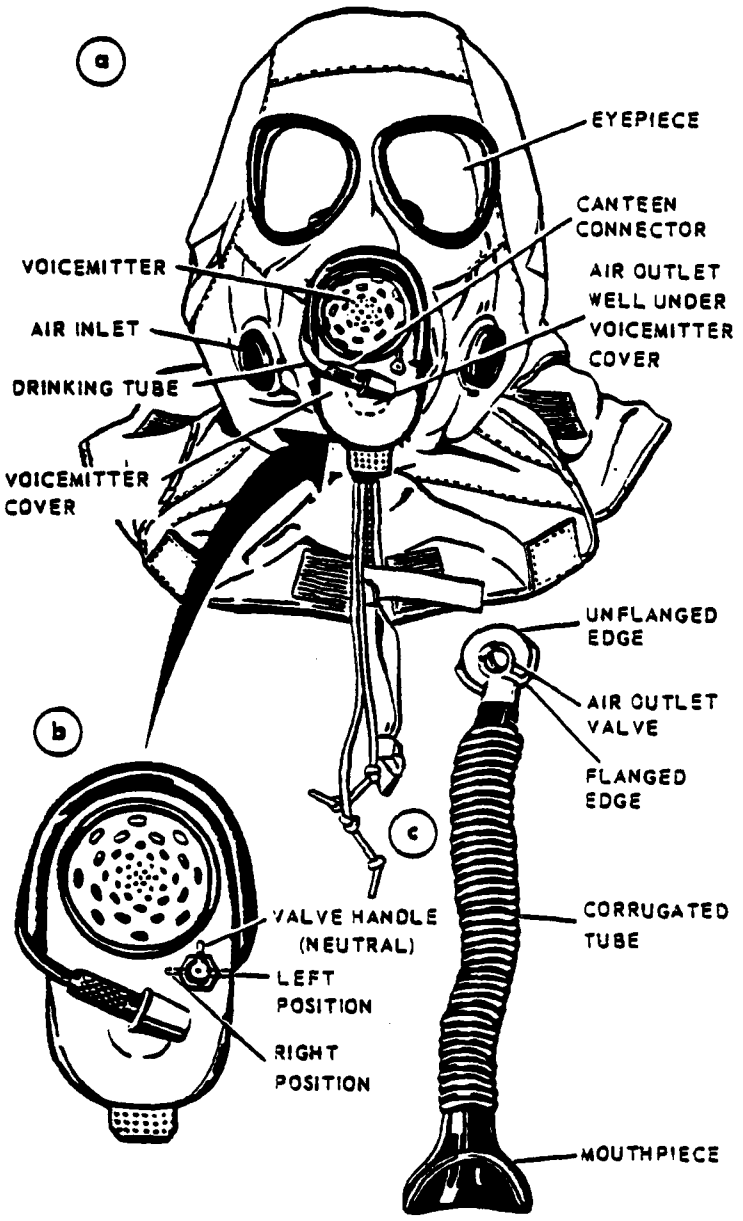


Figure 104. M17A1 Field Protective Mask and M1 Resuscitation Tube.

provide for rapid reoxygenation of blood. Thereafter, the breaths should be blown at a rate of 12 to 20 per minute. If exhalation is noisy, hold the chin up more forcefully or check for the presence of secretions in the casualty's upper airway.

(*e*) When the casualty begins to breathe on his own, adjust your breathing to assist him. Blow when he is inhaling not when he is exhaling.

(*f*) When the casualty continues to breathe regularly, stop blowing air into his lungs but leave the resuscitation tube in place, thus allowing him to inhale uncontaminated air through your mask. Be sure to close his nose when he inhales and open it when he exhales. If he does not continue to breathe regularly, resume mask-to-mouth resuscitation.

(*g*) At such time as the casualty is able to breathe without assistance, remove the resuscitation tube from his mouth and quickly replace his mask. Be sure that his mask is properly sealed. Continue to observe him to insure that he does not stop breathing again as the result of toxic vapor which may have accumulated in his mask.

(6) After completing resuscitation, readjust your mask:

(*a*) Release your bite on the breathing tube bitepiece, thus allowing it to spring back to its *neutral* position (b, fig 104).

(*b*) Disconnect the resuscitation tube from your mask by pulling it outware and upware, and replace the voicemitter cover.

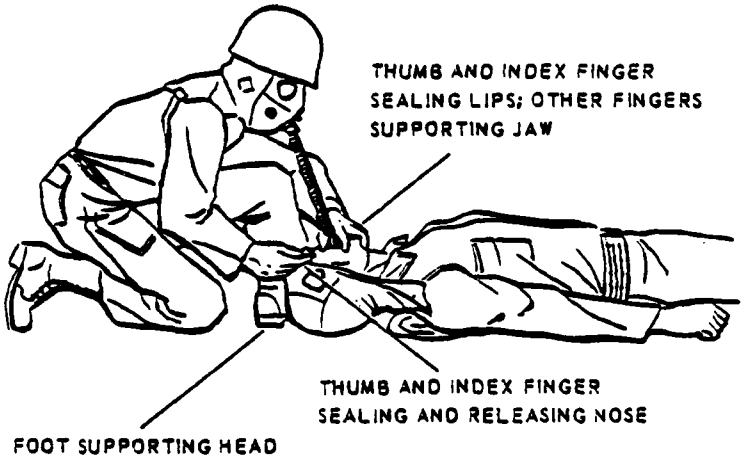


Figure 105. Mask-to-mouth artificial respiration.

(*c*) Wipe the mouthpiece of the resuscitation tube clean and stow it in your carrier.

(7) Notify medical personnel of the casualty's location in accordance with the standing operating procedure of the unit.

53. Blister Agents

a. General. Blister agents (vesicants) include mustards and arsenicals. Relatively low doses may be serious; they can cause serious injury to the eyes, the upper respiratory tract, and the skin. If it is known or suspected that blister agents are being used, you should take cover, mask, and apply powder to your exposed skin, using the skin decontaminating pad from the M13 kit (para 50*c*). If protective clothing has been issued, you should, of course, be wearing it.

b. Symptoms of Blister Agent Poisoning.

(1) *Instant eye pain upon contact with lewisite.* No pain upon contact with mustard.

(2) *Inflammation, blisters, and tissue destruction.* The longer the agent is in contact with the tissue and the larger the area affected, the more serious the injury will become.

c. First Aid Measures for Blister Agent Poisoning. After you have accomplished the applicable steps outlined in paragraph 51*c*, take the following measures as required:

(1) If blisters form, cover them with a loose sterile dressing and secure with bandage (para 16–19). Avoid breaking blisters, if possible.

(2) If a serious burn results from contact with the agent, seek medical treatment.

54. Choking Agents

Your mask provides you complete protection against choking agents such as phosgene and chlorine. You can continue your mission unless exposure to a choking agent prior to putting on your mask has been sufficient to cause difficulty in breathing, nausea, vomiting, or more than the usual shortness of breath upon exertion. If these symptoms occur, loosen your clothing, avoid unnecessary exertion, keep warm, and wait for medical aid.

55. Blood Agents

The so called blood agents consist of the cyanides and arsine. Your mask provides you complete protection against these agents. Exposure to the blood agents before masking, however, can cause rapid,

severe interference with your respiration. If exposure to a cyanide blood agent occurs, the first aid measures are inhalation of amyl nitrite and administration of artificial respiration (para 52*d*). Amyl nitrite ampuls may be issued to you in the event that intelligence indicates a blood agent will be used. Rapid action is paramount, since a person's respiration is immediately affected after exposure to such an agent. "Buddy help" will probably be essential. Crush two ampuls of amyl nitrite and place them within the facepiece of the mask. Repeat this procedure at intervals of 4 to 5 minutes, using two ampuls each time, until normal breathing returns or until a total of eight ampuls have been used. *No more should be given,* as amyl nitrite is poisonous and a larger dose would be harmful. If a person does not respond to this dose, he needs to be treated further by a medical officer.

56. Tear Agents (CS or CN)

a. Should you be exposed to a tear agent before masking, it can cause an increased flow of tears and intense eye pain; it may irritate the upper respiratory tract. If you mask after exposure, be sure to clear your mask and keep your eyes open as much as possible. When you remove your mask after the all-clear signal, the recovery from the tear agent effects will be spontaneous.

b. If heavy skin contamination occurs in a hot, humid, close environment, blistering may result unless the agent is rinsed from the skin with water. If the agent in liquid or solid form has entered your eyes, force your eyes open and flush them with water. A one-fourth percent solution of sodium sulfite, if available, is more effective in dissolving and neutralizing the irritating agent.

57. Vomiting Agents

DM (Adamsite), DA, and DC typify this group of agents. Your mask provides you protection against them. Exposure to such an agent before masking may cause sneezing, nausea, salivation, and vomiting but are not dangerous to healthy individuals. If excessive salivation or vomiting makes lifting your mask necessary, be sure to clear your mask after you reseat it. Vigorous activity help reduce nausea and its duration.

58. Incapacitating Agents

Generally speaking, an incapacitating agent is any compound which can interfere with the performance of military duties by affecting the central nervous system and by producing muscular weakness and abnormal behavior. It is likely that such agents will be dis-

seminated by smoke-producing munitions or aerosols, thus making breathing their means of entry into the body. The use of the protective mask is, therefore, essential for protection against the agents.

a. There is no special first aid for the relief of the symptoms of incapacitating agents. Supportive first aid and physical restraint may be indicated. Weapons and other potentially harmful materials should be removed from the possession of individuals who are suspected casualties. This includes cigarettes, matches, medications, and small items which might be swallowed accidentally. Delirious patients have been known to attempt to eat items bearing only a superficial resemblance to food.

b. Anticholinergic poisoning (BZ type) may produce alarming dryness and coating of the lips and tongue; however there is usually no danger of immediate dehydration. Fluids should be given sparingly, if at all, because of the danger of vomiting and because of the likelihood of temporary urinary retention due to paralysis of bladder muscles. An important medical consideration is the possibility of heatstroke because of stoppage of sweating (para 40*b*). If the environmental temperature is above 78°F., remove excessive clothing from the casualty and dampen him to allow evaporative cooling and prevent dehydration. If the casualty does not readily improve, apply first aid measure for heatstroke (para 40*b*) and seek medical attention.

59. Screening Smokes

a. Titanium Tetrachloride (FM) Smoke. This smoke is relatively nontoxic, but the liquid burns the skin like a strong acid. The smoke is irritating to the nose and throat but only mildly so at the concentration usually found in a smoke cloud. The protective mask should be worn in heavy concentrations of FM. Flush any liquid FM from the skin with water.

b. Sulfur Trioxide-Chlorosulfonic Acid Solution (FS) Smoke. Smoke of this solution causes a prickling sensation on the skin because of the minute acid particles of which it is composed. Liquid FS is highly corrosive to the skin. Splashes of liquid FS in the eyes produces extremely painful acid burns. Exposure to heavy concentrations or prolonged exposure to ordinary concentrations may cause severe irritation of the eyes, the skin, and the respiratory tract. The protective mask should be worn in high FS smoke concentrations. Flush any liquid FS from the skin and eyes with water from your canteen (para 51*c*(3)).

c. HC Mixture (HC). This smoke in high concentrations such as might be encountered near an operating munition, in an inclosed space, or near dense HC smoke screens and in ordinary field concentrations for a prolonged period may have a sufficient amount of zinc chloride built up to produce toxic effects. The protective mask should, therefore, be worn. The effects of exposure to HC may include irritation of the nose and throat, coughing, choking, headache, fever, chest and muscular pains, and suffocation. If nausea, vomiting, or difficulty in breathing occurs, get medical aid as soon as conditions permit. Aspirin will ease general discomfort.

d. Oil Smoke. Inhalation of oil smoke produces no apparent symptoms immediately even though it is inhaled for extended periods. Operating personnel exposed to prolonged high concentrations of oil smoke should wear protective masks as much of the time as possible.

e. White Phosphorus (WP) Smoke. This smoke is harmless; however injuries from burning solid or liquid WP are serious. These burns heal very slowly. For first aid measures, see paragraph 60*a*.

60. Incendiaries

Incendiaries can be grouped as white phosphorous, thickened fuel, metal, and oil and metal. You must learn to protect yourself against these types of incendiaries.

a. White phosphorus (WP) is used primarily as a smoke producer but can be used for its incendiary effect to ignite field expedients and combustible flame material. The burns from WP are usually multiple, deep, and variable in size. When particles of WP get on the skin or clothing, they continue to burn until deprived of air. They also have a tendency to stick to a surface and must be brushed off or picked out. Should burning WP strike you—

(1) Smother the flame by submerging yourself in water or by dousing the WP with water from your canteen or any other source. Urine, a wet cloth, or mud can be used. Copper sulfate pads, if available, can be wet and put over the burning WP. The copper sulfate reacts chemically to coat the phosphorus particles and to prevent further activity. You may be able to take off contaminated clothing quickly before the phosphorus burns through to the skin.

Note. Since WP is poisonous to the system, grease or oil should NOT be used to smother the flame because the WP will be absorbed into the body with the grease or oil.

(2) Keep the WP particles covered with wet material to ex-

clude air until you can remove them or get them removed from your skin.

(3) Remove the WP particles from the skin by brushing them with a wet cloth and by picking them out with a knife, bayonet, stick, or similar object.

(4) Report to a medical facility for treatment as soon as your mission permits.

b. Thickened fuel mixtures (napalm) have a tendency to cling to the clothing and the body surfaces, thereby producing prolonged exposures and severe burns. The first aid for these burns is the same as for other heat burns (para 25 and 34). The heat and irritating gases given off by these combustible mixtures may cause lung damage which must be treated by a medical officer.

c. Metal incendiaries pose special problems. Thermite and thermate particles on the skin should be immediately cooled with water from your canteen and then removed. Even though thermate particles have their own oxygen supply and continue to burn under water, it helps to cool them with water. The first aid for these burns is the same as for other heat burns (para 25). Particles of magnesium on the skin burn quickly and deeply. Like the other metal incendiaries, they must be removed. Ordinarily, the complete removal of these particles should be done by trained personnel at a medical treatment facility, using local anesthesia. The casualty needs medical treatment immediately.

d. Oil and metal incendiaries have much the same effect on contact with the skin and clothing as those discussed in *b* and *c* above. Appropriate first aid measures are described in paragraph 25.

TOPIC ONE TEST QUESTIONS

ADMINISTER FIRST AID IN A TOXIC ENVIRONMENT

UNIT 1

ADMINISTER FIRST AID IN A TOXIC ENVIRONMENT

(Task 888-777-6666)

General Situation: Your unit has been operating in a toxic environment. Your commander has told you to brief new personnel arriving in the unit.

1. Toxic substances can exist in which of the following states?
   A. Liquid
   B. Gas
   C. Solid
   D. All of the above
2. What is considered to be the most important piece of protective equipment for protection against field concentrations of chemical and biological agents?
   A. Field Protective Mask
   B. Protective clothing
   C. M13 Individual Decontaminating and Reimpregnating Kit
   D. Automatic Atropine Injectors

General Situation: You have the need to administer atropine.

3. How many automatic atropine injectors are you issued for your own use?
   A. 3
   B. 4
   C. 2
   D. 5
   E. 1
4. Where are automatic atropine injectors normally carried?
   A. The upper outer pocket of your field protective mask carrier
   B. Your first aid kit
   C. The upper inner pocket of your field protective mask carrier
   D. The breast pocket of your field jacket or fatigue shirt
   E. None of the above
5. Which of the statements below is correct?
   A. To inject atropine the green end of the injector is placed against the bare thigh
   B. To inject atropine the yellow end of the injector is placed against the bare thigh
   C. To inject atropine the green end of the injector is placed against the clothing covering the thigh
   D. To inject atropine the yellow end of the injector is placed against the clothing covering the thigh

General Situation: You have just seen someone administer an atropine injection to themself. You consider the injection unneeded and are observing the person for symptoms of atropine poisoning.

6. Which of the following symptoms is not a symptom of atropine poisoning?
   A. Casualty has dilated pupils
   B. Casualty may have a rash on his face, neck and upper trunk
   C. Casualty has difficulty in swallowing
   D. Casualty complains of being cold
   E. Casualty's skin appears flushed

General Situation: Your buddy has stopped breathing. You need to administer artificial respiration. You are in a toxic environment.

7. Which of the following statements is correct if you are forced to give artificial respiration in a toxic environment?
   A. Both you and the casualty wear your M17A1 Field Protective Masks
   B. Neither you nor the casualty wear your M17A1 Field Protective Mask
   C. You wear your M17A1 Field Protective Mask but the casualty does not wear a mask

8. Where do you connect the M1 Resuscitation Tube on the M17A1 Field Protective Mask?
   A. On the air outlet well which is on the voicemitter cover
   B. On the air outlet well which is part of the drinking tube
   C. On the air outlet well which is under the voicemitter cover
   D. None of the above

General Situation: You suspect you have gotten mustard agent droplets in your eyes.

9. What action should you take?
   A. Give yourself an atropine injection within 2 minutes
   B. Flush your eyes with water from your canteen within 5 minutes
   C. Give yourself an atropine injection within 5 minutes
   D. Do nothing yourself. Wait for medical aid
   E. Flush your eyes with water from your canteen within 2 minutes

General Situation: You suspect that your face is contaminated.

10. What action should you take?
   A. Give yourself an atropine injection within 2 minutes
   B. Give yourself an atropine injection within 5 minutes
   C. Use the skin decontaminating pad from the M13 Kit to decontaminate your face
   D. Immediately wash your face with water from your canteen

General Situation: You suspect that you have been exposed to a nerve agent.

11. Which symptom below is not normally a symptom of nerve agent poisoning?
    A. Possibly, pinpointed pupils of the eyes
    B. Tightness in the chest
    C. An unexplained runny nose
    D. Severe itching of the skin
    E. Marked difficulty in breathing
12. How long before smoking is permitted after exposure to a nerve agent?
    A. At least 48 hours
    B. At least 24 hours
    C. You can smoke immediately if you like
    D. At least one week

General Situation: You have injected yourself with atropine and you are now experiencing a dryness of the mouth.

13. What meaning does this symptom have?
    A. It means that you should immediately administer another injection of atropine
    B. It means that you should wait 5 minutes and then administer another injection of atropine
    C. It means that you should wait 2 minutes and then administer another injection of atropine
    D. It means that the atropine has overcome the dangerous effects of the nerve agent

General Situation: You have been exposed to a cyanide blood agent.

14. What is the recommended first aid measure?
    A. Inhalation of amly nitrite and administration of artificial respiration
    B. Injection of amyl nitrite and administration of artificial respiration
    C. Injection of atropine and administration of artificial respiration
    D. Inhalation of atropine and administration of artificial respiration
    E. None of the above

General Situation: Your commander has told you that you must learn the chemicals associated with each of the different types of chemical agents.

15. What type of chemical agents consist of the cyanides and arsine?
    A. Vomiting Agents
    B. Choking Agents
    C. Blood Agents
    D. Blister Agents
    E. Tear Agents

16. What type of chemical agents include mustards and arsenicals?

A. Blister Agents

B. Vomiting Agents

C. Tear Agents

D. Choking Agents

E. Blood Agents

17. What type of chemical agents includes phosgene and chlorine

A. Choking Agents

B. Vomiting Agents

C. Tear Agents

D. Blood Agents

E. Blister Agents

18. What type of chemical agents include DM (Adamsite), DA, and DC?

A. Blister Agents

B. Vomiting Agents

C. Tear Agents

D. Choking Agents

E. Blood Agents

General Situation: The enemy is moving under cover of smoke. The smoke is reaching your location.

19. What action should you take if you are in a smoke cloud of Titanium Tetrachloride (FM) smoke?

A. No action is required

B. Flush any liquid FM from the skin with water

C. Immdiately give yourself an injection of atropine

D. Use the skin decontaminating pad to absorb any liquid FM

20. Which symptom listed below is not normally a symptom of inhaling HC smoke?

A. Coughing and choking

B. Irritation of the nose and throat

C. Prickling sensation of the skin

D. Headache

E. Fever

END OF TEST

TOPIC TWO STUDY MATERIAL

ADMINISTER FIRST AID FOR COMMON EMERGENCIES

SOLDIER'S NOTICE

SKILL COMPONENT (SC)

-- Description

- o TESTS 1 TASK
- o 20 QUESTIONS ON TASK
- o ALL QUESTIONS ARE MULTIPLE CHOICE WITH 3 to 5 POSSIBLE CHOICES

SC Test 1: Administer First Aid for Common Emergencies (333-323-4321)

*You must pass 16 of the 20 questions to score GO

*SMPM 1, 2, 3, 6, 8, 9, 10, and 11

333-323-4321

ADMINISTER FIRST AID FOR COMMON EMERGENCIES

CONDITIONS

Given: Daylight hours in both hot and cold climates in which sterile compresses, burn lubricant, salt tablets, water and ice are available.

STANDARDS

From memory provide first aid for:

minor wounds and burns
foreign body in the eye, ear, nose or throat
foot trouble
bites of snakes and spiders and stings of scorpions
skin eruptions from poisonous plants
conditions caused by extreme heat or cold
carbon monoxide poisoning
drowning
electrical shock
unconsciousness

PERFORMANCE MEASURES

1. Know the 3 steps for treating a minor wound.
2. Identify the two types of minor burns and the treatment for each.
3. Know the procedures to take for removal of various foreign objects from the eye.
4. Know the procedure to take for removal of a foreign body from the ear, nose, or throat.
5. Know the proper procedure for care of the feet.
6. Know the proper procedure for treating bites of snakes and spiders and stings of scorpions.
7. Know the proper procedure for identifying and treating skin eruptions caused by poisonous plants.
8. Identify and understand the procedures for treatment of conditions caused by extreme heat.
9. Identify and understand the procedures for treatment of conditions caused by cold.

10. Identify the symptoms and the procedures for treatment of carbon monoxide poisoning.
11. Know the proper procedures for treating drowning casualties.
12. Know the proper procedures for treating electrical shock casualties.
13. Know the proper procedures to use for casualties who are unconscious.

REFERENCES

FM 21-11 (Chapter 4)

CHAPTER 4

COMMON EMERGENCIES

33. Minor Wounds

Most small wounds, such as cuts, do not usually bleed very much. Infection from contamination (para 15*a*) is the principal danger. If you receive a minor wound, take the following first aid measures:

a. Do not allow anything to touch the wound, except as described in *b* and *c* below.

b. If a disinfectant such as Tincture Benzalkonium Chloride (app B) is available, apply it to the wound. (In no instance should solutions stronger than 1:1000 or 1:750 be used.)

c. Place a sterile compress over the wound without allowing it to touch anything else (para 16) and secure it in place with a bandage (para 18).

34. Minor Burns

Minor burns may be caused by exposure to dry heat, hot liquids, chemicals, electricity, or rays of the sun. Minor burns are of two types:

a. Small Burns Which Include Blistering or Charring. Since the skin is most likely to break when it is blistered or charred, cover it with a sterile compress (para 17) to protect it from contamination and possible infection. Secure the compress in place with a bandage (para 18).

b. Burns With No Blistering or Charring. If the burn does not cause the skin to blister, char, or break, it is a minor burn even though it may cover a large area of the body, as in mild sunburn. It is not necessary to cover such a burn with sterile compress. The lubricant in Phase I Unit (app B) may be applied in a thin layer to relieve pain. Do not apply this lubricant to a burn in which the skin is blistered, charred, or broken.

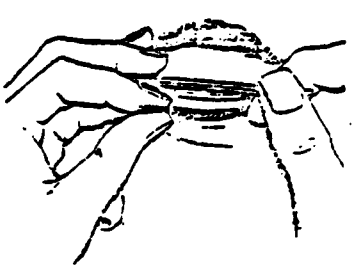
35. Foreign Body in the Eye

a. If a foreign particle gets into the eye, do not rub the eye. If the particle is beneath the upper eyelid, grasp the eyelashes of the upper lid and pull the lid up and away from contact with the surface of the eyeball. Hold the eyelid in this manner until tears flow freely. The tears will frequently flush out the particle. If this technique fails, attempt to remove it as shown in figure 83.

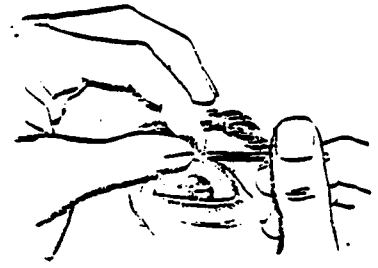
b. If the foreign particle is glass or metal or it cannot be removed by the techniques described in *a* above and illustrated in figure 83, bandage both of the casualty's eyes (para 19*b*) and get him to a medical treatment facility.

(a) INSPECT EYEBALL AND LOWER LID. GENTLY REMOVE OBJECT WITH MOIST CLEAN CORNER OF HANDKERCHIEF.

(b)



IF THE OBJECT IS NOT IN LOWER LID, INSPECT UPPER LID. GRASP EYELASHES WITH THUMB AND INDEX FINGER AND PLACE MATCH STICK OR SMALL TWIG OVER LID.



PULL LID UP AND OVER STICK. EXAMINE INSIDE OF LID WHILE THE CASUALTY LOOKS DOWN. GENTLY REMOVE PARTICLE WITH CLEAN CORNER OF HANDKERCHIEF.

Figure 83. Removing a foreign particle from the eye.

Note. For very minimal injuries, bandaging only one eye may suffice. For any major injury, or in case of any doubt, both eyes must be bandaged. If only one eye is bandaged, the casualty will use his unaffected eye. Since eye movements are synchronized, use of the unaffected eye may result in movement of the affected one, thereby subjecting it to further injury.

c. If caustic or irritating material, such as battery acid, or ammonia, gets into the eye, immediately flush it with a large volume of water. To flush the right eye, turn the head to the right side; to flush the left eye, turn the head to the left side. This prevents the caustic or irritating material from being washed into the other eye.

36. Foreign Body in the Ear, Nose, or Throat

a. Never probe in an attempt to remove a foreign body from the ear. An insect in the ear may be removed simply by attracting it with a flashlight held to the ear. If this fails, it may be drowned or immobilized by pouring water into the ear. Foreign objects in the ear can sometimes be flushed out with water. However, if the object is something which will swell when wet, such as a seed or particle of wood, do not pour water into the ear.

b. Probing into the nose will generally jam a foreign object tighter. Damage to the nasal passages can also result. Try to remove the object by gently blowing the nose. If this fails, seek medical aid.

c. Coughing will frequently dislodge a foreign object from the throat. If this fails and the object can be reached, try to remove it with the fingers; but be careful to avoid pushing it farther down the throat. There is great danger of respiratory obstruction if the object cannot be removed, so get medical aid as quickly as possible.

37. Foot Trouble

Foot trouble can be avoided by taking proper care of the feet as discussed FM 21–10. Should you develop foot trouble such as a callus or corn, a blister, or athlete's foot, get medical aid. Do not cut a callus or corn, as this can cause a serious infection. If a blister develops and medical aid is not available, follow the first aid measure illustrated in figure 84.

38. Bites of Snakes and Spiders and Stings of Scorpions

Bites from snakes, black widow spiders, and brown recluse spiders and stings from scorpions can be prevented by following the measures discussed in FM 21–10. Should a person receive a bite or sting

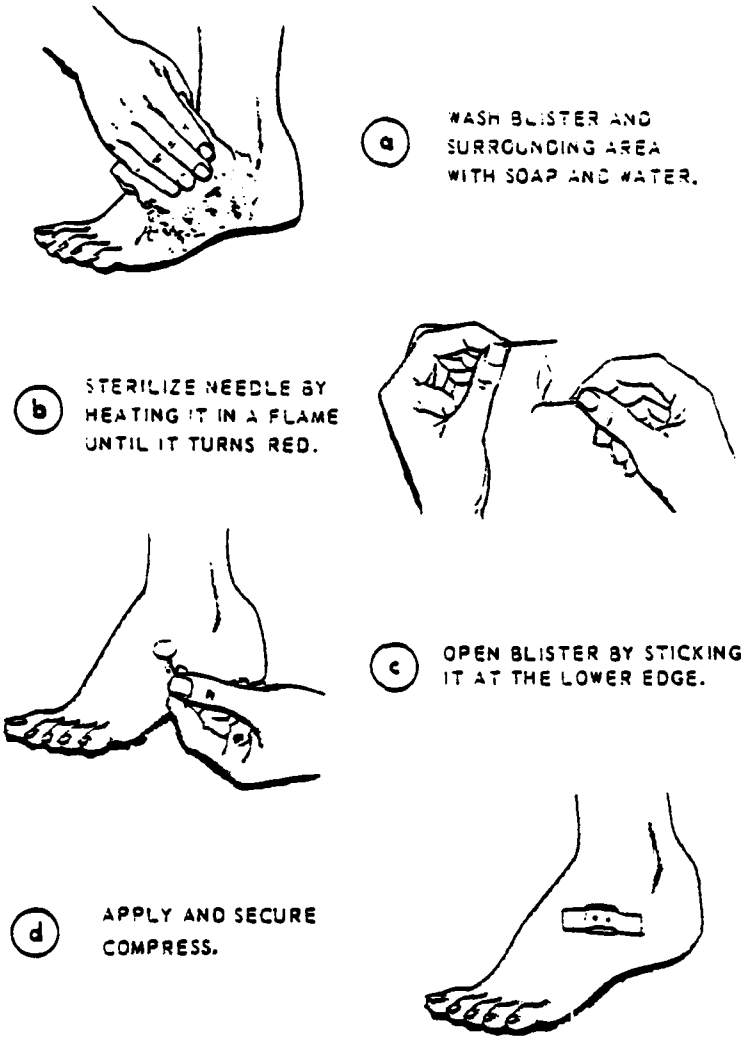


Figure 84. First aid for a blister.

from one of these venomous animals, the first aid measures outlined below should be followed.

a. Snake Bite.

(1) Keep the casualty as quiet as possible. Do not allow him to walk or run. If you can, kill and keep the snake so that it can be

identified to aid medical personnel in determining the proper antivenom serum for the casualty.

(2) Make the casualty as comfortable as possible, preferably in a sitting position, and immediately immobilize (para 32) a bitten limb in a position which is below the level of the heart.

(3) Improvise a tourniquet from a necktie, a handkerchief, or a strip of cloth and place it between the bite site and heart at a point 2 to 4 inches above the site of the bite. Tighten the tourniquet enough to stop the flow of blood in the vessels near the skin surface but not tight enough to stop the arterial flow or the pulse. As soon as the veins under the skin stand out prominently, the appropriate flow of blood has been properly halted. Also, the presence of a pulse in the part below the tourniquet indicates the continuance of arterial flow. The pulse can be checked by placing two fingers, not the thumb, over the pressure point in the wrist or ankle as appropriate (fig 14).

(4) Since medical aid is urgent in all cases of poisonous snake bite, send someone to summon assistance. If a litter or a vehicle is available, transport the casualty to the nearest medical treatment facility at once.

(5) Observe the casualty closely for signs of difficult breathing, as some types of snake poison affect the breathing mechanism. Should the casualty stop breathing, initiate artificial respiration (para 8) at once.

b. Black Widow or Brown Recluse Spider Bite.

(1) Keep the casualty as quiet as possible.

(2) If ice is available, place an ice pack around the region of the body where the bite occurred to keep the venom from spreading.

(3) Get the casualty to the nearest medical treatment facility without delay.

c. Scorpion Sting. In most areas of the world, scorpions are not highly dangerous; however in South America, Mexico, the Middle East, and some parts of North Africa, certain types can cause death if proper treatment is not administered.

(1) For an ordinary scorpion sting, put a piece of ice, if available, on the site of the sting as soon as possible. This may decrease the absorption of the venom by the body. Baking soda applied as a paste to the site of the bite will often relieve the pain.

(2) If the site of the sting is on the face, neck, or genital organs or if the sting is from a scorpion in the areas of the world

mentioned above, keep the casualty as quiet as possible and get him to the nearest medical treatment facility without delay.

39. Skin Eruptions from Poisonous Plants

In some persons the sap or juice of certain plants will cause skin eruptions. The most common plants are poison ivy, poison oak, and poison sumac. Skin eruptions from these plants can be prevented by learning how to identify the plants and by taking the proper control measures (FM 21–10). Should you develop a skin eruption several days after possible exposure to any of these plants, avoid scratching it and seek medical aid. The skin eruption first appears as redness and swelling accompanied by severe burning and itching; blisters appear later.

40. Conditions Caused by Extreme Heat

Conditions caused by extreme heat are heat exhaustion, heatstroke, and heat cramps, as well as sunburn and prickly heat. These conditions can be prevented by proper acclimatization to heat, adequate consumption of water and salt, and consistent practice of the prescribed preventive measures (FM 21–10).

a. Heat Exhaustion. This condition is caused by excessive loss of water and salt from the body. The symptoms of heat exhaustion are headache, excessive sweating, weakness, dizziness, and muscle cramps. Also, the skin is pale, cool, moist, and clammy. Heat exhaustion may come on gradually or suddenly. A victim of heat exhaustion should be given first aid as follows:

(1) Lay the casualty in a cool shaded area and loosen his clothing.

(2) If the casualty is conscious, give him cool salt water to drink. Prepare the salt water by dissolving two crushed salt tablets (one-fourth teaspoonful of table salt) in a canteen (quart) of cool water. The casualty should drink 3 to 5 canteenfuls during a period of 12 hours.

b. Heatstroke. Prolonged exposure to high temperature may cause heatstroke, which is sometimes referred to as "sunstroke." The first sign of heatstroke may be stoppage of sweating which causes the skin to feel hot and dry. Collapse and unconsciousness may come suddenly or may be preceded by headache, dizziness, fast pulse, nausea, vomiting, and mental confusion. It is necessary to work fast to save the life of a heatstroke casualty, as the heat regulators of the body have been damaged and the temperature may rise as high as 108° F. The following first aid measures should be administered promptly:

(1) Immerse the casualty in the coldest water available. If ice is available, add it to the water.

(2) If a cold water bath is not possible, get the casualty into the shade, remove his clothing, and keep his entire body wet by pouring water over him. Cool him further by continuously fanning his wet body.

(3) Transport him to the nearest medical treatment facility at once and continue to cool his body on the way.

(4) When the casualty becomes conscious, give him cool salt water to drink (*a*(2) above).

c. Heat Cramps. Heat cramps are painful spasms of the muscles, usually those of the legs, arms, and abdomen. They may be either mild or severe. Cramps are due directly to loss of salt from the body. Give a casualty with heat cramps large amounts of salt water to drink (*a*(2) above). If he has severe heat cramps, it may be necessary to send him to a medical treatment facility.

41. Conditions Caused by Cold

Conditions caused by cold are trench foot, immersion foot, frostbite, and snow blindness. These conditions can be prevented by practicing the prescribed preventive measures (FM 21–10).

a. Trench Foot. Trench foot is an injury which results from fairly long exposure of the feet to wet conditions, generally at temperatures from approximately freezing to 50° F. If the feet are also inactive, the possibility of developing trench foot is even greater. Trench foot can be very serious; it can lead to loss of toes or parts of the feet. Usually a symptom of trench foot is numbness. There may be a tingling or aching sensation or cramping pain. If exposure of the feet has been prolonged and severe, the feet may swell so tightly that pressure closes the blood vessels and cuts off the circulation. Should you develop trench foot, dry your feet thoroughly and get to a medical treatment facility by the shortest means possible. If transportation is available, avoid walking.

b. Immersion Foot. Immersion foot is similar to trench foot (*a* above) except in the manner in which it is caused. It results from immersion of the feet in water or constant wetness of the feet for a prolonged period, usually in excess of 12 hours. Immersion foot will develop more rapidly if the water is below 50° F. It can occur, however, when the feet are exposed even to warm water for a period exceeding 24 hours. In immersion foot the soles of the feet become wrinkled and white; standing or walking becomes extremely painful. Other portions of the body may be similarly af-

fected. Should you develop immersion foot, dry your feet thoroughly and get to a medical treatment facility by the shortest means possible. If transportation is available, avoid walking.

c. Frostbite. Frostbite is the injury of tissue from exposure to cold. The body parts most easily frostbitten are the cheeks, nose, ears, chin, forehead, wrists, hands, and feet. Frostbite may involve only the skin, or it may extend to a depth below the skin. Deep frostbite, which is much more serious, requires different first aid to avoid or minimize the loss of the parts of the fingers, toes, hands, or feet. Frostbitten skin is whitish, stiff, and numb rather than painful. For this reason, soldiers must watch one another's face and hands for signs of frostbite. If the part has been numb for only a short time, the frostbite probably involves only the skin; otherwise assume it to be deep. The following measures should be taken for frostbite:

(1) *First aid measures for frostbite involving only the skin.*

Note. Do NOT warm or rewarm frostbitten parts by such measures as massage, exposure to open fire, cold water soaks, or rubbing with snow.

(*a*) *Parts of the face.* Cover the frostbitten part with your warm hands until pain returns.

(*b*) *Hands.* Place the bare hands next to the skin in the opposite armpits.

(*c*) *Feet.* In the most sheltered area available, place the bare feet under the clothing and against the abdomen of another soldier.

(2) *Measures to take when deep frostbite occurs.*

(*a*) Get to a medical treatment facility by the shortest means possible. If transportation is available, avoid walking.

(*b*) Protect the frostbitten part from additional injury, but do NOT attempt to treat it or thaw it in any way. Thawing in the field increases the possibilities of infection, further damage, and gangrene. There is less danger of walking on your feet while they are frozen than after they have been thawed. Thawing may occur spontaneously during transportation to the medical facility; but this cannot be avoided, as the body in general must be kept warm.

d. Snow Blindness. Snow blindness is the effect which glare from an icefield or snowfield has on the eyes. This condition can occur even in cloudy weather. In fact, it is more likely to occur in hazy, cloudy weather than when the sun is shining. The early stages of snow blindness can be recognized by the scratchy feeling in the eyes when the eyelids are closed. Should a person develop snow-blindness, his eyes should be covered with a dark cloth to shut out

all light; then he should be taken to a medical treatment facility at once.

42. Carbon Monoxide (CO) Poisoning

a. Carbon monoxide poisoning can be severe, prolonged, and sometimes fatal. It results from inhaling carbon monoxide which is a colorless, tasteless, and practically odorless gas produced by the incomplete combustion of coal, oil, and other fuels used in such equipment as motor vehicles, field ranges, and lighting and heating devices. This carbon monoxide destroys the ability of the red blood cells to carry the needed oxygen to the body tissues. Carbon monoxide poisoning is usually the result of faulty equipment, improper use of equipment, or inadequate ventilation. It can be prevented by following the precautionary measures discussed in FM 21–10.

b. The symptoms of carbon monoxide poisoning come on rapidly and in quick succession. Dizziness, headache, noises in the ears, and throbbing in the temples are quickly followed by a feeling of sleepiness and weakness. Vomiting and convulsions may occur, followed by unconsciousness and death. The skin and lips are often bright red. The individual who is becoming poisoned may realize what is taking place, but he may not have enough strength left to get into the fresh air. Under circumstances in which there is muscular exertion or where there are extremes of temperature or humidity, the effects of poisoning act more rapidly.

c. The following first aid measures should be taken for a person who is overcome by carbon monoxide:

(1) Move the casualty into fresh air immediately and administer artificial respiration (para 8).

(2) Keep him quiet and transport him to a medical treatment facility.

43. Drowning

Drowning occurs when air is shut off from the airway by water or and other fluid, causing spasm of the vocal cords and blockage of the airway. Many casualties who appear lifeless may recover if artificial respiration (para 8) is performed promptly and efficiently. Speed is essential. Every moment of delay decreases the casualty's chance of survival. It is frequently possible to start the mouth-to-mouth method of artificial respiration (para 8*b*) before the casualty is brought ashore. As soon as his head is clear of the water and his mouth is within reach of your mouth, clear his airway and start artificial respiration. If other rescuers can help

carry the casualty ashore, do not interrupt the artificial respiration. Once the casualty is ashored do not waste valuable seconds to turn him in an attempt to drain water from his lungs; but continue the artificial respiration.

44. Electrical Shock

Electric shock accidents frequently result from contact with a "live" wire and occasionally occur when a person is struck by lightning. If a person has come in contact with an electric current, take the following steps:

a. Turn off the switch if it is nearby, but do not waste time looking for it. Instead use a dry wooden pole, dry clothing, dry rope, or some other material which will not conduct electricity to remove the person from the wire. If a pole is not handy, simply drag the casualty off the wire by means of a loop of dry rope or cloth (fig 85). Do not touch the wire or the casualty with your bare hands or you will also get a shock.

b. Administer artificial respiration (para 8) immediately after

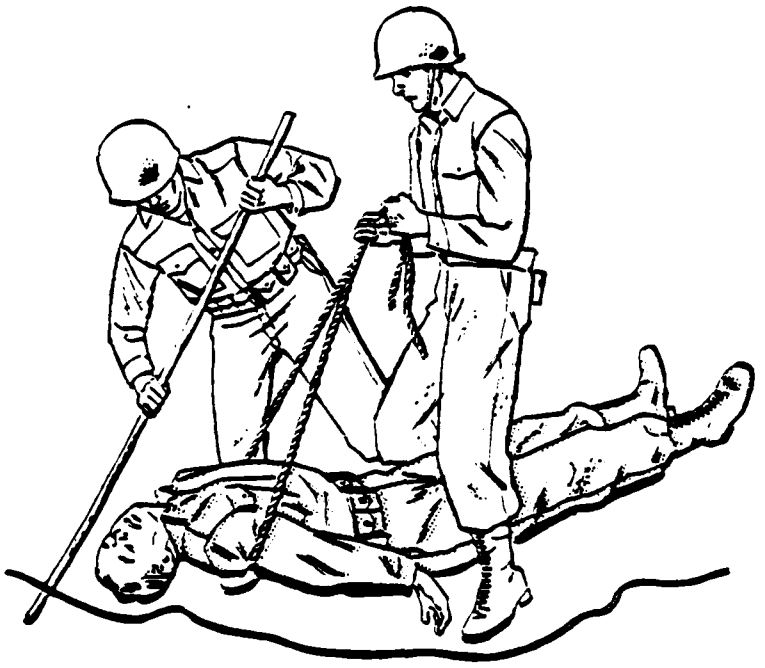


Figure 85. Rescuing an electric shock casualty.

freeing the person from the wire, as electric shock causes breathing to cease.

45. Unconsciousness

It is often impossible to find the cause of unconsciousness. Bleeding, heatstroke, or head injury may be the cause.

a. If a casualty is unconscious, apply the lifesaving measures A B C D (chap 2) as appropriate. If he has a head injury or a heatstroke, apply the special measures discussed in paragraph 21 or 40*b*. If the casualty remains unconscious after first aid measures have been applied, be sure to place him on his side or on his abdomen with his head turned to one side to prevent his choking on vomitus, blood, or other fluids (para 14*f*(2)). DO NOT give an unconscious casualty liquid.

b. If a casualty has merely fainted, he will regain consciousness in a few minutes. If an ammonia inhalant solution (app B) is available, break the ampul and place it near his nose several times for a few seconds each time. If he is in a sitting position, lay him down gently. Loosen his clothing, apply a cloth which has been wet with cool water to his face, and let him lie quietly. Anytime that a person is about to faint while sitting up, lower his head between his knees so that blood may flow to his head. Hold him so that he does not fall and injure himself.

TOPIC TWO TEST QUESTIONS

ADMINISTER FIRST AID FOR COMMON EMERGENCIES

UNIT 1

ADMINISTER FIRST AID FOR COMMON EMERGENCIES

(Task 333-323-4321)

General Situation: You are in a field situation and have just cut yourself while opening your C-rations.

1. What is the principal danger involved with a small wound?
   A. Excessive bleeding
   B. Infection from contamination
   C. Interference with the operation of equipment

General Situation: Your buddy has received a minor burn.

2. What first aid measure should be taken if the small burn includes blistering or charring?
   A. No first aid measure should be taken
   B. A burn lubricant should be applied in a thin layer to relieve pain
   C. Break the blister with a sterile needle and then cover with a sterile compress
   D. The burn should be covered with a sterile compress
3. What first aid measure should be taken if the burn does not involve blistering or charring?
   A. No first aid measure should be taken
   B. The burn should be washed with a saline solution
   C. The burn should be covered with a sterile compress
   D. Apply burn lubricant in a thin layer to relieve pain
   E. A shot of penicilin should be administered to prevent infection

General Situation: A soldier in your squad has a foreign body in his eye.

4. What action should be taken if the foreign particle is glass or metal?
   A. Bandage the affected eye and get the casualty to a medical treatment facility
   B. Bandage both of the casualty's eyes and get him to a medical treatment facility
   C. Try to remove the foreign particle by flushing gently with water
   D. Try to remove the foreign particle with moist clean corner of handkerchief
   E. None of the above

General Situation: Your combat unit has been operating in North Africa. Your commander has told you to brief a group of replacements on first aid measures to be taken for bites of local poisonous snakes, spiders and stings of scorpions.

5. In which of the positions below should you place a person who has been bitten by a poisonous snake?
   A. Lying position
   B. Standing position
   C. Sitting position
   D. Kneeling position
6. Which statement below is correct when applying a tourniquet to a snake bite casualty?
   A. The tourniquet is placed between the bite site and heart at a point 2 to 4 inches above the site of the bite.
   B. Two tourniquets are applied. One above the bite site and one below the bite site.
   C. The tourniquet is placed on the bite site
   D. None of the above is correct
7. How tight should you tighten the tourniquet?
   A. Tight enough to stop all flow of blood for five minutes.
   B. Tight enough to stop both the flow of blood in the vessels near the skin surface, the arterial flow and the pulse
   C. Tight enough to stop the flow of blood in the vessels near the skin surface but not tight enough to stop the arterial flow or the pulse
   D. Tight enough to stop all flow of blood for 15 minutes. After 15 minutes the tourniquet should be loosened for five minutes
8. Which of the following is not a standard treatment for a bite from a black widow or brown recluse spider bite?
   A. Keep the casualty as quiet as possible
   B. Get the casualty to the nearest medical treatment facility without delay
   C. Apply a tourniquet between the bite site and heart at a point 2 to 4 inches above the site of the bite
   D. If available, place an ice pack around the region of the body where the bite occurred

9. Which statement below is correct for a sting from a scorpion found in North Africa?

   A. Scorpion stings are not dangerous in North Africa. Therefore, apply baking soda as a paste to the site of the bite to relieve the pain

   B. Keep the casualty as quiet as possible and get him to the nearest medical treatment facility without delay

   C. Neither of the statements above is correct

General Situation: Your squad has been travelling by foot for 9 hours through an extremely hot region. You suspect that the heat has affected one of your squad members.

10. Which symptom below is not characteristic of heat exhaustion?

   A. Muscle cramps

   B. Weakness

   C. Dizziness

   D. Stoppage of sweating

11. What is the first preferred action that should be taken for an individual suffering from heatstroke?

   A. Perform no first aid. Transport the casualty immediately to the nearest medical treatment facility

   B. Give the casualty cool salt water to drink

   C. Immerse the casualty in the coldest water available. If ice is available, add it to the water

General Situation: Your unit has been transferred to a cold, wet environment. You have been told to learn the symptoms and treatment for trench foot, immersion foot, frostbite, and snow blindness.

12. Trench foot is an injury which results from fairly long exposure of the feet to wet conditions. At what temperatures does it generally occur?

   A. Any temperature below 32° F

   B. Approximately 30° to 60° F

   C. Any temperature below 0° F

   D. Approximately freezing to 50° F

13. Which of the following is not a symptom of trench foot?
    A. Burning sensation
    B. Numbness
    C. Tingling sensation
    D. Swelling of the feet
    E. Aching sensation or cramping pain
14. Immersion Foot result from immersion of the feet in water or constant wetness of the feet for a prolonged period. How many hours of immersion does it usually take before you will develop immersion foot?
    A. Usually in excess of 6 hours
    B. Usually in excess of 12 hours
    C. Usually in excess of 48 hours
    D. Usually in excess of 24 hours
    E. Usually in excess of 3 hours
15. Which of the following is not a symptom of frostbitten skin
    A. Skin is numb
    B. Skin is whitish
    C. Skin is stiff
    D. Skin is painful to the touch
16. What first aid measure would you try first for frostbite involving only the skin?
    A. Soak the frostbitten member in cold water
    B. Rub the frostbitten member with snow
    C. Massage the frostbitten member
    D. Warm the frostbitten member in front of an open fire
    E. None of the above
17. What measure should be taken when deep frostbite occurs?
    A. Protect the frostbitten part but do not attempt to treat it or thaw it in any way
    B. Get to medical treatment facility by the shortest means possible
    C. Both of the two measures above should be taken
18. What is the recommended procedure for snow blindness?
    A. Cover the eyes with a dark cloth and then take the casualty to a medical treatment facility at once
    B. Cover the eyes with moist bandages and wait 1 hour to see if the problem goes away
    C. Flush the eyes with a saline solution
    D. None of the above

General Situation: Carbon monoxide poisoning can be severe, prolonged, and sometimes fatal. You have been told to memorize the symptoms of carbon monoxide poisoning.

19. Which of the symptoms shown below is not a common symptom of carbon monoxide poisoning?

    A. Headache
    B. Sleepiness
    C. Dizziness
    D. Noises in the ears
    E. Rash on face and hands

General Situation: You are attempting to revive a drowning casualty who appears lifeless.

20. What procedure should be used first for reviving the casualty?

    A. If possible start the mouth-to-mouth method of artificial respiration before the casualty is brought ashore
    B. Get the casualty ashore and immediately begin artificial respiration
    C. Get the casualty ashore and immediately strike the chest with your fist in an effort to restart breathing
    D. Get the casualty ashore and turn him in an attempt to drain water from his lungs

END OF TEST

TOPIC THREE STUDY MATERIAL

MARKING OF CONTAMINATED OR DANGEROUS LAND AREAS

SOLDIER'S NOTICE

SKILL COMPONENT (SC)

-- Description

- o TEST 4 TASKS
- o 1 TO 9 QUESTIONS ON EACH TASK
- o ALL QUESTIONS ARE MULTIPLE CHOICE WITH 4 or 5 POSSIBLE CHOICES

SC Test 1: Mark Contaminated or Dangerous Land Areas (957-999-8053)

*You must pass _____ of the 6 questions to score GO

*SMPM 1, 2, 3, 4, 5, 6, 7, 8 and 9

SC Test 2: Use Standard-A Chemical Protective Overgarment Ensemble (957-432-3508)

*You must pass 1 of the 1 questions to score GO

*SMPM 2

SC Test 3: Use M-17 Series Chemical, Biological Field Protective Mask and CB Protective Mask Carrier (666-777-8888)

*You must pass _____ of the 4 questions to score GO

*SMPM 1, 2, 3 and 4

SC Test 4: Use ABC M-13 Individual Decontamination and Reimpregnating Kit, the M258 Skin Decontaminating Kit, Chemical Agent Detector Kits, and Chemical Defensive Items (000-111-2222)

*You must pass _____ of the 9 questions to score GO

*SMPM 1, 2, 3, and 5

942-999-9068

MARKING OF CONTAMINATED OR DANGEROUS LAND AREAS

CONDITIONS

Given: Daylight hours in a combat environment in which there are suspected contaminated or dangerous land areas.

STANDARDS

Identify from memory the characteristics of markers used for marking contaminated or dangerous land areas.

PERFORMANCE MEASURES

1. Identify the shape of markers used for designating contaminated or dangerous land areas
2. Identify Chemical Contamination Marker
3. Identify Biological Contamination Marker
4. Identify Radiological Contamination Marker
5. Identify Chemical Minefield Marker
6. Identify Boobytrap Marker
7. Identify Unexploded Munitions Marker
8. Mark contaminated or dangerous land areas
9. Know special radiological marking procedures

REFERENCES

FM 21-40 (C1, Appendix A)

957-432-3508

USE STANDARD-A CHEMICAL PROTECTIVE OVERGARMENT ENSEMBLE

CONDITIONS

Given: Standard-A Chemical Protective Overgarment Ensemble and a chemical environment in which the ensemble is worn.

STANDARDS

Identify from memory the characteristics and the maintenance and replacement procedure for the ensemble.

PERFORMANCE MEASURES

1. Describe make-up of Overgarment ensemble
2. Describe characteristics of Overgarment ensemble
3. Describe maintenance of protective clothing
4. Describe replacement procedures for protective clothing

REFERENCES

FM 21-40 (C1, Appendix B)

000-111-2222

USE ABC M-13 INDIVIDUAL DECONTAMINATION AND REIMPREGNATING KIT, M258 SKIN DECONTAMINATING KIT, CHEMICAL AGENT DETECTOR KITS, AND CHEMICAL DEFENSIVE ITEMS

CONDITIONS

Given: ABC M-13 Individual Decontamination and Reimpregnating Kit, the M258 Skin Decontaminating Kit, Chemical Agent Detector Kits, and chemical defensive items.

STANDARDS

Describe and answer questions about each of the decontamination kits and chemical defensive items.

PERFORMANCE MEASURES

1. Describe characteristics of ABC M-13 Individual Decontamination and Reimpregnating Kit.
2. Describe characteristics of M258 Skin Decontaminating Kit
3. Describe the use of chemical defensive items
4. Describe the use of biological protective equipment
5. Describe Chemical Agent Detector Kits

REFERENCES

FM 21-40 (C1, Appendix B)

666-777-8888

USE M-17 SERIES CHEMICAL, BIOLOGICAL FIELD PROTECTIVE MASK AND CB PROTECTIVE MASK CARRIER

CONDITIONS

Given: M-17 Series Chemical Biological Field Protective Mask and CB Protective Mask Carrier.

STANDARDS

Describe from memory the characteristics of the Protective Mask and CB Protective Mask Carrier.

PERFORMANCE MEASURES

1. Describe M17A1 Field Protective Mask
2. Describe Accessories
3. Describe the criteria for replacement of filter elements
4. Describe CB Protective Mask Carrier

REFERENCES

FM 21-40 (C1, Appendix B)

APPENDIX A

Marking Of Contaminated Or Dangerous Land Areas

(STANAG 2002)

DESCRIPTION OF MARKERS (SIGNS)

This appendix discusses markers or signs that are used in areas containing radiological, biological, and chemical contamination; chemical minefields; boobytraps; and unexploded munitions. The signs are in the shape of a right isosceles triangle (90° by 45° by 45°) and are made of plastic, wood, metal, or other rigid material, with holes or "ears" that are used for hanging them above the ground. They are placed on wire boundary fences, poles, trees, or rocks. The coloring and markings of the signs are in accordance with STANAG 2002 and are illustrated in Figure A-1. The signs may be mass-produced by major commands for distribution to subordinate units or may be made locally. The base of the triangle should be about 28 cm (11 inches) and the opposite sides about 20 cm (8 inches).

CHEMICAL CONTAMINATION MARKER

The triangle is yellow on both sides. The word "GAS" in red 5 centimeter (2 inch) block letters is placed on the side of the markers facing away from the contamination (front). Fluorescent paint is used, if available. The name of the agent, if known, and the date and time of detection are also placed on the front of the marker at the time of emplacement with paint, marking pencil, or grease pencil.

BIOLOGICAL CONTAMINATION MARKER

The triangle is blue on both sides. The letters "BIO" in red (fluorescent paint, if available) 5 centimeter (2 inch) block letters are placed on the side of the marker facing away from the contamination (front). The name of the agent if known, and the date and time of detection are also placed on the front of the marker at the time of emplacement.

RADIOLOGICAL CONTAMINATION MARKER

The triangle is white on both sides. The word "ATOM" in black 5 centimeter (2 inch) block letters is placed on the side of the markers facing away from the contamination (front). The dose rate, date, and time of reading, and the date and time of burst, if known, are also placed on the front of the marker at the time of emplacement.

CHEMICAL MINEFIELD MARKER

The triangle is red on both sides. On the side facing away from the contamination (front) appear the words "GAS MINES" in yellow 2.5 centimeter (1 inch) block letters (fluorescent paint, if available) with a horizontal yellow 2.5 centimeter (1 inch) stripe underneath the lettering. The chemical

agent in the mines and the date of emplacement may also be inscribed on the front of the marker if desired by the commander.

BOOBYTRAP MARKER

The triangle is red on both sides. On the side facing away from the booby-trapped area (front), a horizontal white 4 centimeter (1 3/4 inch) stripe is painted.

UNEXPLODED MUNITIONS MARKER

The triangle is red on both sides. On the side facing away from the dangerous area (front), a white bomb is painted. The bomb should be at least 10 centimeters (4 inches) tall.

MARKING OF AREAS

Chemically, biologically, and radiologically contaminated areas, chemical minefields, boobytraps, and unexploded munitions will be marked by the triangular signs described in preceding paragraphs, unless the area is to be abandoned to threat forces. The nature of the contamination or danger of the considered area is to be indicated by the colors of the signs. These include-

- The primary color, used for the background of the front surface and for the entire back surface.
- A secondary color, used for additional markings and inscriptions on the front surfaces.

MULTIPLE HAZARDS

Areas that contain more than one type of contamination or other hazard will be marked with the relevent signs placed close to each other. However, the sign "GAS MINES" will be assumed to include the presence of high explosive mines and boobytraps as well as chemical mines.

MARKING OF SIMULATED CONTAMINATED AREAS

Simulated contaminated areas are marked exactly as if they were real.

PRIMARY AND SECONDARY COLORS

DANGER	PRIMARY COLORS	SECONDARY COLORS	
		MARKINGS	INSCRIPTIONS
RADIOLOGICAL CONTAMINATION	WHITE	NONE	BLACK
BIOLOGICAL CONTAMINATION	BLUE	NONE	RED
CHEMICAL CONTAMINATION	YELLOW	NONE	RED
CHEMICAL MINEFIELDS	RED	YELLOW STRIPE	YELLOW
BOOBYTRAPPED AREAS	RED	WHITE STRIPE	NONE
UNEXPLODED MUNITIONS	RED	WHITE (BOMB)	NONE

SPECIAL RADIOLOGICAL MARKING PROCEDURES

The marking of radiologically contaminated areas merely indicates a hazard, the extent of which must be determined by newly arrived troops by means of instrument readings, surveys, and information from other units.

- At the discretion of the commander, a radiologically contaminated area need *not* be marked when a military advantage will be obtained by not doing so. In this case positive measures must be taken to warn other friendly forces of the radiologically contaminated area.
- Signs are placed on all probable routes leading into contaminated areas at the points where the dose rate reaches 1 rad/hr measured 1 meter above the ground.
- Levels of radiation less than 1 rad/hr normally are not marked even though significant doses might be produced by long stays in areas of old contamination. Units planning prolonged stays in any area during a nuclear war must check the area with radiac instruments whether or not it is marked.
- Signs are corrected or moved periodically to account for radioactive decay by the unit responsible for the area.
- Commanders leaving an area or otherwise giving up responsibility for an area should leave perimeter signs in place, unless the area is being abandoned to the threat forces. The command taking over the responsibility for the area will continue the periodic correction or movement of the signs or remove them when they are no longer necessary.
- Dumps for radiologically contaminated materials are marked at intervals around the perimeter with signs that are visible from one to another.

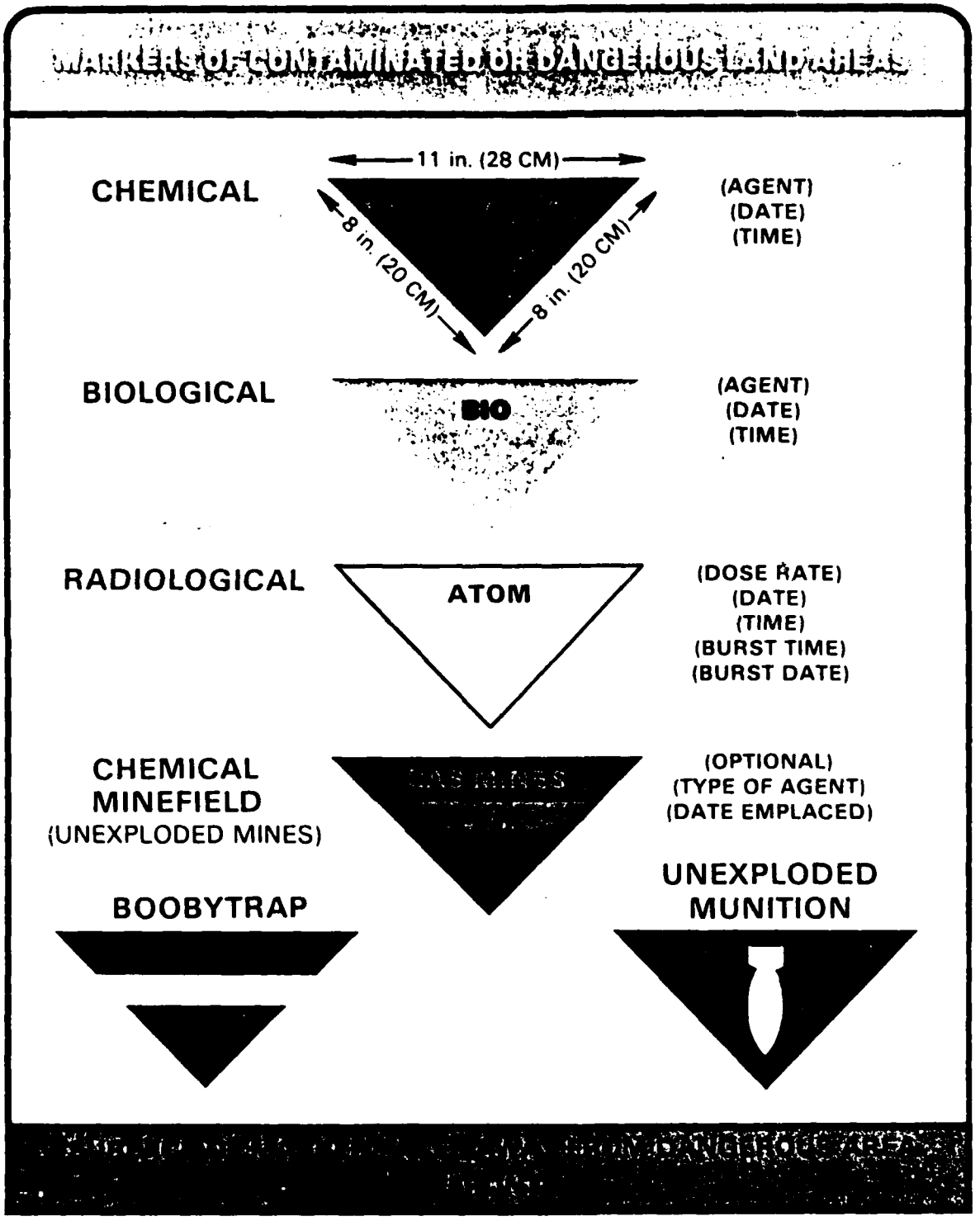

MARKERS OF CONTAMINATED OR DANGEROUS LAND AREAS
CHEMICAL
11 in. (28 CM)
8 in. (20 CM)
8 in. (20 CM)
(AGENT)
(DATE)
(TIME)
BIOLOGICAL
BIO
(AGENT)
(DATE)
(TIME)
RADIOLOGICAL
ATOM
(DOSE RATE)
(DATE)
(TIME)
(BURST TIME)
(BURST DATE)
CHEMICAL
MINEFIELD
(UNEXPLODED MINES)
GAS MINES
(OPTIONAL)
(TYPE OF AGENT)
(DATE EMPLACED)
BOOBYTRAP
UNEXPLODED
MUNITION

Figure A-1

APPENDIX B

NBC Protective Clothing and Defensive Equipment

INDIVIDUAL CLOTHING AND EQUIPMENT

Personnel are provided with individual protection against chemical and biological (CB) agents when operating under the threat of CB attack. Chemical protective clothing, the CB mask and hood, and other protective and defensive items for the individual are described in the following paragraphs.

CHEMICAL PROTECTIVE CLOTHING

Different types of chemical protective clothing are available for wear in different weather conditions and for special purposes. Permeable clothing allows the passage of air and moisture through the fabric; impermeable clothing does not. Combat troops normally will be issued standard-A permeable chemical protective clothing. TM 10-277 describes and illustrates how various items of chemical protective clothing are worn.

● *Types of Permeable Protective Clothing.*

1 The Standard-A Chemical Protective Overgarment Ensemble. This expendable two-piece overgarment (Figure B-1) consists of one coat (shirt) and one pair of trousers with fly front; it is packaged in a sealed vapor barrier bag to provide protection against rain, moisture, and sunlight. The bag also has an instruction label. Three pairs of cushion sole socks and one pair of gloves are issued separately. The shirt and trousers are made of materiel having an outer layer of nylon-cotton and an inner layer of charcoal impregnated polyurethane foam that gives protection against vapors, aerosols, and small droplets of nerve and blister agents. The overgarment is intended to be worn over the duty uniform; however, in high temperatures, it may be worn directly over the underwear. Basis of issue will be determined ★ by the theater commander. The overgarment is not designed to be decontaminated and reimpregnated for reuse. It is discarded within 6 hours after being contaminated with liquid chemical agents or when it becomes worn or ripped.

★

2 The Standard-A Chemical Protective Liner Ensemble. This ensemble consists of one shirt liner and one trouser liner (Figure B-2), three pairs of cushion sole socks, and one pair of cotton gloves inside a clothing bag. The shirt and trouser liners have been treated (impregnated) with XXCC3 impregnite to give protection against vapors, aerosols, and small droplets of nerve and blister agents. They are worn under the issue trousers and

Figure B-1

shirt and over the underwear. The outer layer of clothing consists of the appropriate environmental clothing. It is designed to be ★ laundered or decontaminated and retreated.

● *Maintenance of Protective Clothing.* This clothing is designed to form a barrier to protect the body against vapors and droplets of chemical agents. Any tears, rips, holes, or worn places in the material will allow the agent to penetrate the barrier. Therefore, protective clothing must be carefully inspected to insure serviceability.

● *Replacement Guide for Protective Clothing.* The following general guidance may be used to determine when to decontaminate or dispose of and replace protective clothing and also the duty uniform when worn as part of a protective ensemble.

1 Small tears, rips, or worn areas in the Standard-A Chemical Protective Overgarment Ensemble may be repaired with the individual issue patch accessory, according to instructions. Unrepairable items will be discarded and replaced.

2 When other protective clothing is torn, is ripped, or has heavily worn areas (elbows, knees, or seat), exchange it for replacement clothing as soon as possible.

3 When the clothing is visibly contaminated with liquid chemical agent (see paragraph below), one of two actions should be taken depending on the amount of contamination.

● If the agent on the clothing is isolated in a small area or is only visible in a small amount, the clothing should be quickly decontaminated using the M13 kit (see WARNING below).

WARNING: Although the M13 kit will remove or neutralize most of the liquid agent, the clothing may continue to give off dangerous vapors. Hence, THE MASK SHOULD BE WORN EVEN AFTER DECONTAMINATION IS COMPLETED.

● If the contamination is too heavy to be quickly decontaminated by the individual using his M13 kit, the clothing should be disposed of and replaced as soon as possible.

4 An aid in determining whether a visible liquid on the clothing is, in fact, a chemical agent is to have one or two individuals in any element which is usually together, such as a fire team or gun crew, tape a piece of M8 detector paper (page B-9) on their uniforms. This paper will show by color change whether or not any liquid which it contacts is a possible nerve or blister agent. It should be placed on the exterior uniform where it will be readily exposed to any liquid contact but will not be easily torn off.

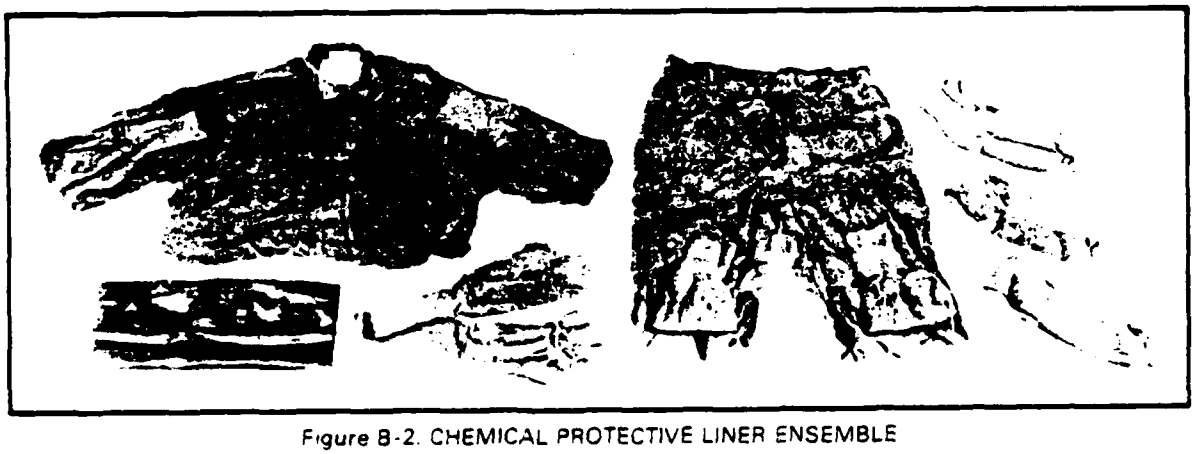


Figure B-2. CHEMICAL PROTECTIVE LINER ENSEMBLE

M17-SERIES CHEMICAL BIOLOGICAL FIELD PROTECTIVE MASKS

These masks, when properly fitted and worn with the hood, give protection against field concentrations of all known enemy chemical agents in vapor or aerosol form by filter elements that fit in the cheeks of the facepiece. They filter the contaminated air to remove the agents but they do not produce oxygen. When the air has a low oxygen content or when individuals are in tunnels or caves with a heavy concentration of aerosolized particles such as burning smoke mixtures, the protective mask will not provide breathable air. The M17-series masks also do not protect against ammonia vapors or carbon monoxide. These masks are commonly referred to as the "protective mask", "gas mask", or "mask", as may be appropriate; however, protective mask is the preferred term.

● *M17A1 Field Protective Mask.* The M17A1 is the standard-A field protective mask (Figure B-3). It has as an accessory a resuscitation tube for giving mask-to-mouth artificial respiration by a masked individual to an individual casualty in a contaminated atmosphere. It has the following components: a voicemitter to facilitate communications, a device for drinking water from the canteen while masked (including a water canteen

Figure B-3. M17A1 FIELD PROTECTIVE MASK WITH M6A2 HOOD

cap), two outserts to protect the eyeglasses and to improve operations in low temperatures, and a waterproof bag in which the ★ mask can be enclosed to protect the filter elements from damage by water (for example, during wading operations). The M17A1 mask will replace on an attrition basis the M17 mask, which is not equipped with either the water-drinking device or the resuscitation tube.

● *Accessories.* Additional accessories for use with the M17-series masks include the items listed below; figure B-4 illustrates these accessories.

1 The ABC-M6A2 CB protective mask hood is designed for semi-permanent attachment to the M17-series masks to provide protection to the head and neck from chemical agent vapors or liquid droplets.

2 The ABC-M4 CB mask winterization kit is used under artic conditions to prevent frost accumulation on the inlet valve caps.

● *Filter Element Replacement Criteria.* Matched-pair filter elements (one for the right side and one for the left side of the mask) are designed for protection against normal field concentrations of all known threat chemical agents and are considered adequate for all forseeable field use. Both filters must be replaced carefully under the following circumstances: when directed by the division or higher headquarters, after pro- ★ longed usage, on initiation of chemical warfare and once every 30 days thereafter; if they impose severe impedence to breathing; after immersion in water; if on visual examination they are found to be damaged or unserviceable; or if the lot numbers do not match. See ★ TM 3-4240-279-10 and -20P for a description of the four different types of filter sets and the differences among the models and their replacement criteria.

1 Filters in protective masks that are used extensively in mask confidence training exercises should be replaced before the masks are issued for field use.

2 Filter elements normally are replaced by individuals supervised by NBC-trained personnel under unit control on the battlefield, and the contaminated filter elements are disposed of by burying them under a few inches of soil or immersing them in DS2. Replacement filter elements are stocked at unit supply.

● *CB Protective Mask Carrier.* The carrier is provided with a shoulder strap, a waist strap, and pockets. The pockets are used to carry accessories and the following additional items: the M13 decontaminating and reimpregnating kit, a book of chemical agent detector paper, and other items that may be prescribed by the commander such as amyl nitrite ampuls and nerve agent antidote injectors.

TANK AND AIRCRAFT PROTECTIVE MASKS

Specially designed chemical-biological protective masks are available for crewmen of armored vehicles and for crewmen of aircraft. Criteria for replacement of canisters for these masks are similiar to the criteria for the M17-series masks as described on pages B-4 and B-5.

● *Tank CB Protective Masks, M25-Series.* ★ These masks provide protection against all known enemy chemical and biological agents in vapor or aerosol form. When used in a tank or other armored vehicle, the mask is coupled to a gas-particulate filter unit such as the ★ M13A1, which forces air to the facepiece, thus enhancing its wearability in hot weather. When the mask is worn outside the tank, the individual inhales air through the M10A1 protective mask canister. An antifogging kit is a component of the mask. See TM 3-4240-280-10 for instructions on the care and ★ maintenance of these two masks.

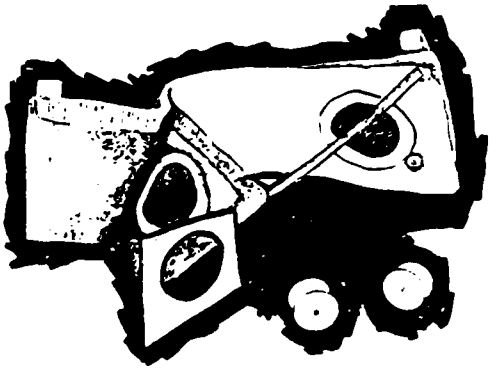
1 A microphone assembly in the mask is used to communicate with other crew members through the vehicle

ITEMS USED WITH M17 SERIES PROTECTIVE MASKS

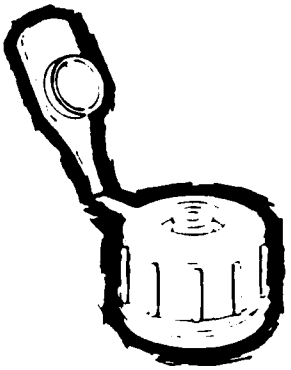
MASK IN WATERPROOFING BAG

PROTECTIVE HOOD

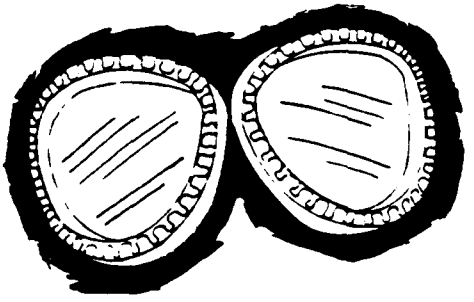
RESUSCITATION TUBE



WINTERIZATION KIT



WATER CANTEEN CAP



EYELENS OUTSERTS

Figure 8-4

communications system. The M25 and M25A1 masks have built-in microphones for ★ transmitting to crew members. They also have the capability of transmitting messages to other vehicles having FM receivers. The M25 and the M25A1 are essentially the same, however, the M25A1 mask has a higher forehead tab than the M25.

2 Accessories include the ABC-M5 CB mask hood and winterization kit. The hood is attached to the mask as described in the appropriate technical manual.

● *Aircraft CB Protective Mask, M24.* This mask provides protection against all known threat chemical and biological agents in vapor or aerosol form. The mask can be attached to the aircraft oxygen supply system by the use of an M8 adapter kit. It provides protection both in the aircraft and on the ground by the M10A1 canister. The facepiece is not force-ventilated as it is for the tank mask. A microphone element-and-bracket assembly is installed in the nose cup. An antifogging kit and an antiglare eyelens outsert are components of the mask. See TM 3-4240-219-14 for instruction on the care and maintenance of this mask. Accessories include the M7 aircraft protective mask hood and a winterization kit. The hood is attached to the mask as described in the technical manual.

ABC-M13 INDIVIDUAL DECONTAMINATING AND REIMPREGNATING KIT

The M13 kit is carried in the large external pocket of the carrier for the M17-series masks and the appropriate pocket of other mask carriers. General instructions for the use of the kit are printed on the container, however, these instructions have been altered as discussed below because of the introduction of the M258 kit, which is specially designed for skin decontamination.

● The container for the M13 kit is a plastic can equipped with a plastic pull-handle slip-on lid. It contains the following items:

1 A small decontaminating pad (instructions call it the skin pad) filled with "Fuller's earth" powder.

2 Two cloth bags filled with a decontaminating and reimpregnating compound (XXCC3). Each bag contains a capsule of B1 chemical agent detector dye.

3 A single-edge cutter.

● This kit provides the individual with a means of detecting liquid chemical agent contamination and decontaminating his clothing and equipment.

1 The small pad (skin pad) is used to decontaminate the inside of the protective mask facepiece. The pad will slip over two fingers in such a way that one side can be used to blot the agent from the inside of the facepiece and the other side to dust and rub over the contamination. This action only absorbs small amounts of liquid agent and, therefore, a mask which has heavy contamination inside should not be used. This problem should not exist if the mask is kept in a closed carrier until needed.

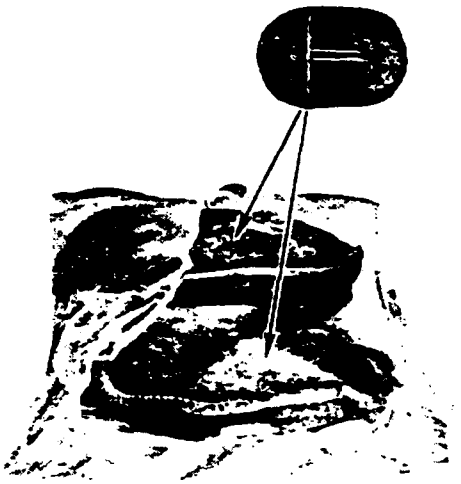
2 The cloth bags are used for decontamination and reimpregnation. They are also used to detect chemical contamination; the dye capsule inside the bag is crushed and kneaded into the compound and the bag is subsequently rubbed over clothing and equipment. The presence of nerve and blister agents contamination is disclosed by red or brown color changes on the contaminated spots. Further rubbing with the cloth bags decontaminates and reimpregnates, eliminating the smear hazard of liquid contamination. This does not eliminate the vapor hazard that may exist. ★

3 The single-edge cutter is used to cut out spots of heavy contamination on clothing.

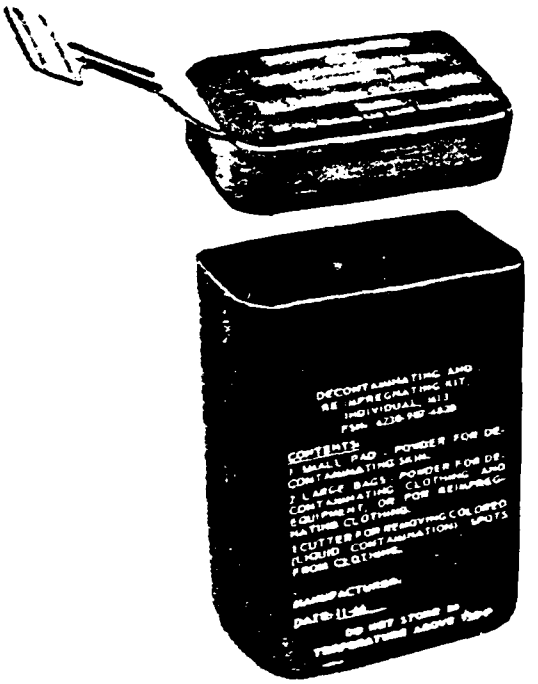
M258 SKIN DECONTAMINATING KIT

The external appearance of the M258 kit is similar to that of the M13 kit. The only differences are the instructions and the web strap and snap clip on the M258 for attaching

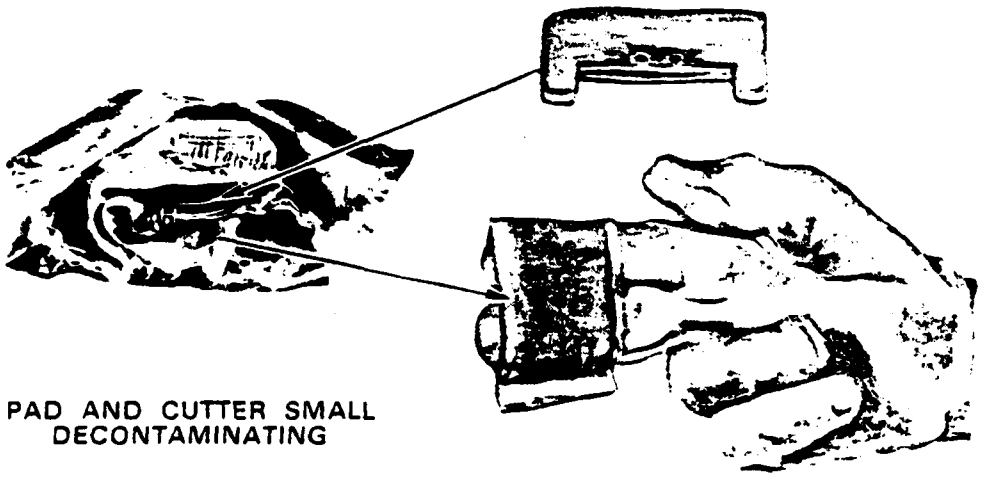
M13 INDIVIDUAL DECONTAMINATING AND REIMPREGNATING KIT



TWO CLOTH
DECONTAMINATING BAGS
WITH DYE CAPSULE INSIDE



KIT CONTAINER WITH PLASTIC LID



PAD AND CUTTER SMALL
DECONTAMINATING

Figure B-5

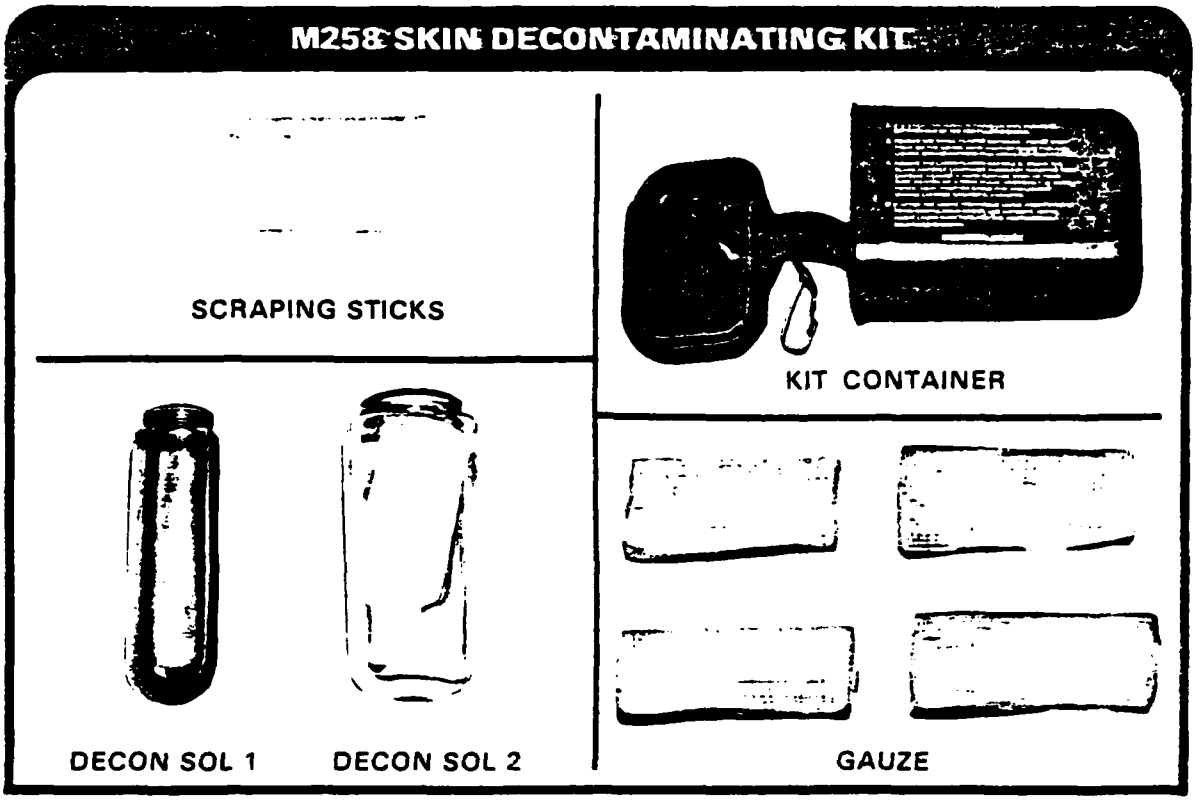


Figure B-6

it to your mask carrier or pack harness. Inside the lid of the M258 is a metal spike which is used for puncturing the decontamination solution containers. The plastic can contains four gauze pads, two scraping sticks, and two plastic capsules containing the decontaminating solution. Complete details on this kit are in TM 3-4230-213-10. These components are used as follows:

● A gauze pad is used to soak up liquid agent from the surface of the skin. After as much agent as possible has been removed in this manner the pad is thrown away. If time permits, the pad may be buried under several inches of soil or immersed in DS2.

● If the contamination is a thick liquid which the pad will not absorb, the contamination is scraped off the skin's surface using one of the scraping sticks. After this action is completed, the stick is also thrown away, buried, or immersed in DS2, if time permits.

● Using the spike in the kit's cover, punch a hole in the round capsule (solution #1). Wet a gauze pad with the solution and wipe the area of contaminated skin with the wet pad. Throw the pad away, bury it, or immerse it in DS2.

● The square plastic capsule contains a glass vial which must be broken by striking the capsule against a hard object. After the vial is broken, the capsule is shaken vigorously to throughly mix the contents. Puncture the capsule using the spike and wet another piece of gauze with the solution. The contaminated skin area is again wiped throughly with this pad and the pad thrown away, buried or immersed.

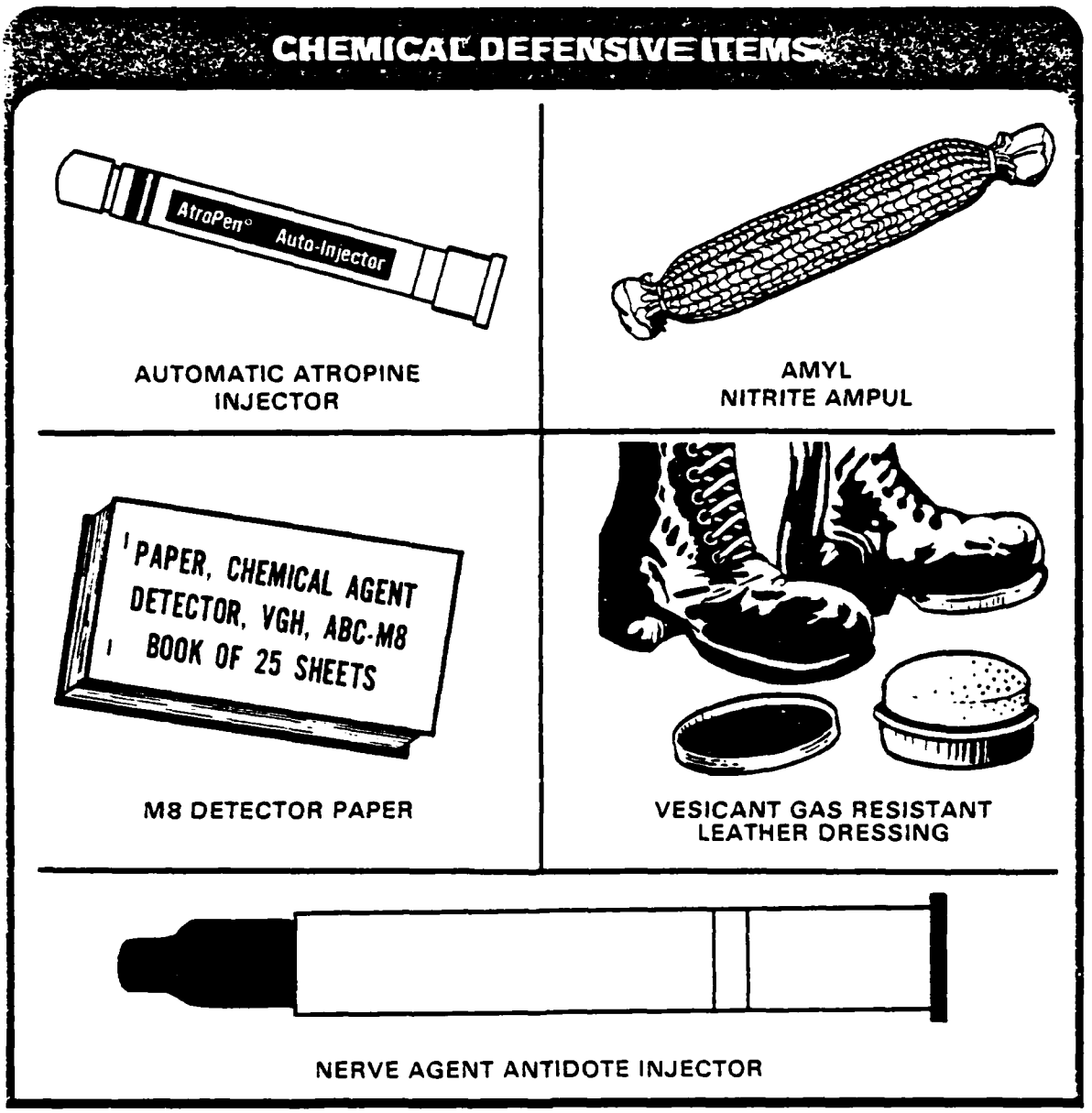


Figure B-7

CHEMICAL DEFENSIVE ITEMS

Other chemical defensive items available for issue to individuals are described below and illustrated in Figure B-7.

● *Leather Dressing, Vesicant Gas Resistant, M2.* When properly applied to leather boots, this leather dressing (protective dubbing) makes the leather resistant to penetration by chemical agents.

1 The most effective method for applying the dressing to leather combat boots is the hot-dip (immersion) method. This process involves complete immersion of the boots in melted dressing, where both the interior and exterior surfaces are completely treated. The interior of the boots must be thoroughly wiped to remove excess dressing. Detailed ★ procedures for applying the leather dressing are on the container.

2 When the hot-dip method cannot be used and prestocked, treated boots are not available, warm leather dressing can be hand rubbed into the inside and outside surfaces of clean boots. This method is not as effective as the hot-dip method and should be used only as an emergency measure until properly treated boots are available.

● *Chemical Agent Detector Paper, ABC-M8.* A booklet of 25 sheets of this paper may be issued to individuals and is also a component of the chemical agent detector kits. The sheets are impregnated with chemical compounds that turn dark green, yellow, or red when contacted by V-or-G-type nerve agents or blister (mustard) agents, respectively, in liquid form. This paper must touch the liquid agent to insure a positive test; it does not detect vapor. It is best suited for use on nonporous materials; the test is not always reliable on porous material which can absorb the agent. Because some solvents also cause the paper to change color, it is unrealiable for determining the completeness of decontamination by the use of solvents. A color chart is included in the booklet to aid in interpreting the tests.

● *Amyl Nitrite Ampuls.* When intelligence or experience indicates that blood agents may be used by threat forces, amyl nitrite ampuls (yellow) will be issued to individuals for use in first aid. When required, amyl nitrite will be issued on the basis of one box of 12 ampuls per individual. The first aid use of these ampuls is covered in CHAPTER 5.

● *Automatic Atropine Injector.* The spring-operated, automatic atropine injectors (green and yellow), which have long been a standard item for the treatment of nerve agents are now being replaced by a more effective antidote (see below). As the new nerve agent antidote injectors become available to units the atropine injectors will no longer be carried by the individual soldier. These items will be retained by medical personnel for their treatment of nerve agent casualties.

● *Nerve Agent Antidote Injector.* Two spring-operated, nerve agent antidote injectors normally are carried by the individual in the top outside pocket of the mask carrier. Because the size of this pocket varies, the injectors may not fit into it on some carriers. In this case put the injectors in the rear inside pocket. These injectors are used for nerve agent first aid and function the same as the atropine injectors, i.e., the safety is removed and the small end is pressed against the thigh until the mechanism functions. This solution has a relatively high freezing point and should be removed from the carrier and placed inside the field uniform in cold weather (below 45°F). The first aid use of this injector is covered in CHAPTER 5.

BIOLOGICAL PROTECTIVE EQUIPMENT

The protective masks and hoods discussed previously in this appendix provide excellent protection from biological aerosols. These items, along with the duty uniform and gloves, protect against bites from vectors such as mosquitoes and ticks that carry disease-causing microorganisms. The clothing should be fully buttoned and the trouser legs tucked into the boots. Covering the skin also reduces the possibility of a biological agent entering the body through cuts and scratches. Standard insect repellents and insecticides are effective against most disease-carrying insects.

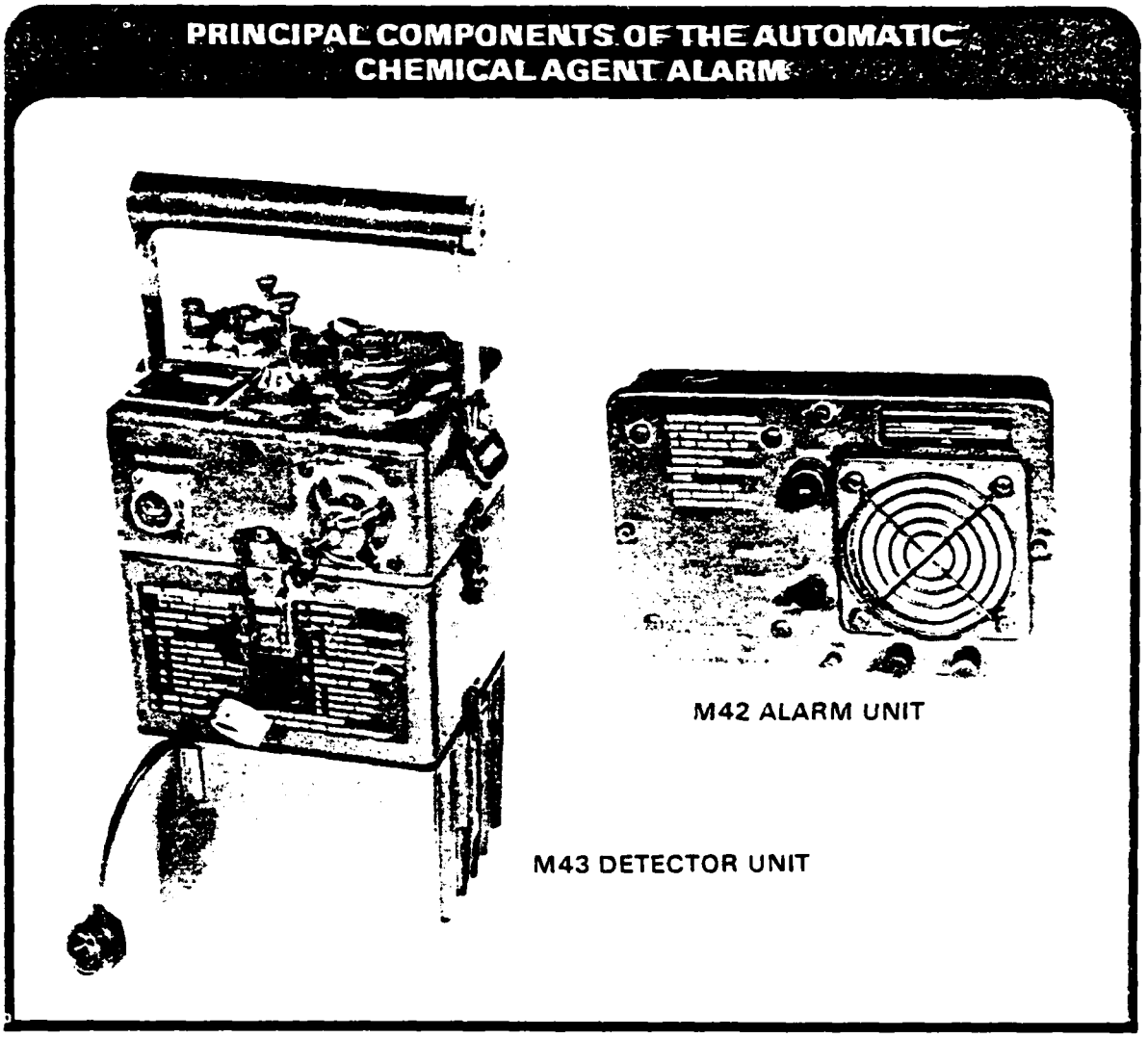


Figure B-8

UNIT NBC DEFENSE EQUIPMENT

AUTOMATIC CHEMICAL AGENT ALARM

★ The automatic chemical agent alarm is an automatic miniature chemistry laboratory which continuously samples the air. The automatic chemical agent alarm system detects nonpersistent and persistent threat agents when they are in vapor or inhalable aerosol form. It sounds the alarm when it detects nerve agent (G or V), blood agent (Cyanide compounds), or choking agents (Phosgene). The alarm will be issued by MTOE. TC 3-3, *How to Use the Automatic Chemical Agent Alarm* , provides a ready reference for the use of the alarm while TM 3-6665-225-12 provides instructions for use by operator and organizational personnel.

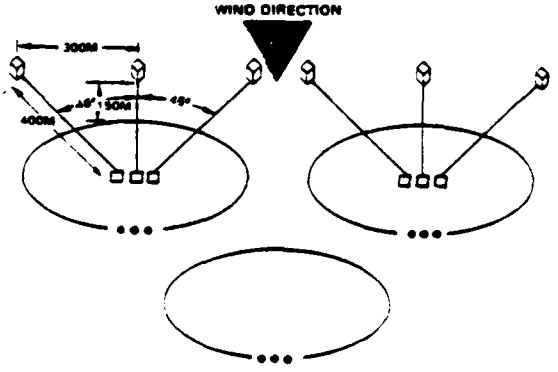
● *Principal Components (Figure B-8).*

1 The M43 Detector Unit of the automatic chemical agent alarm continuously samples the air at its location and indicates the presence of nerve (G and V-type) agents, choking agents, and blood agents by an adjustable low level audible signal. It weighs about 15 pounds with the BA 3517/U battery attached (6.5 pounds without battery) and is designed to operate unattended for 12 hours between servicings.

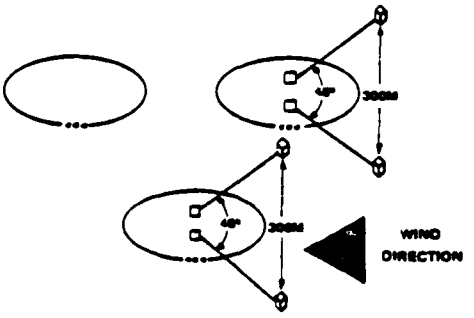
2 The M42 Alarm Unit provides an audible and visual or visual only warning signal when the detector unit is positioned upwind of the using unit and is connected to the alarm unit with WD-1 field wire.

● *Associated Equipment.* The equipment associated with the system includes the mounting kits that are used when the alarm system is mounted on certain vehicles and an M10 Power Supply that allows the alarm to be operated from an AC power supply of either 110 or 220 volts. The M10 power supply converts this AC voltage to 30 VDC.

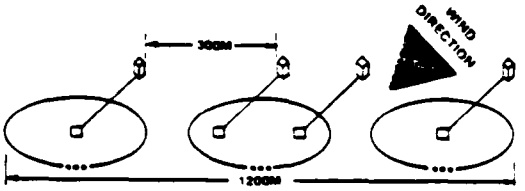
Shown below is a company in defensive position with six detectors deployed. The actual number of alarm systems per unit will vary depending upon the TOE. The 300 meter distance between the M43 detectors reduces the probability that agent clouds might drift through holes in the array. This array provides a high probability of detecting an off-target attack within a reasonable warning time.



Shown below is an array using four detectors with the wind direction coming from the right flank of the unit. A significant difference between a four-detector array and a six-detector array is that with only four detectors the array must be shifted when the wind direction shifts greater than 20 degrees. Also shown is another point which is often overlooked in chemical warfare defenses: the detector is oriented on wind direction, not on the direction of the enemy.



Shown below is a situation where four detectors are emplaced with three platoons of line. Note the orientation on the wind direction. When the automatic chemical agent alarms are mounted on vehicles consideration must be given to wind direction for the protection of the main body.



For maneuvering units, upwind security elements employ the automatic chemical alarm system to provide early warning for the main body. Increased MOPP is required for security elements since they have no early warning capability. However, reduced MOPP may be possible for the main body. The commander determines the MOPP based on the mission, threat, and heat loading factors discussed in chapter 5.

The single most important factor in employing the system is to make sure that the detector is upwind of the position or formation to be protected.

M43 DETECTOR UNITS REQUIRED TO PROTECT A UNIT FRONT

Unit Front Size (Meters)	M43 Detector Units Required
1-36	1
37-372	2
373-708	3
709-1044	4
1045-1380	5
1381-1716	6
1717-2052	7
2053-2388	8
2389-2724	9
2725-3060	10

CHEMICAL AGENT DETECTOR KITS

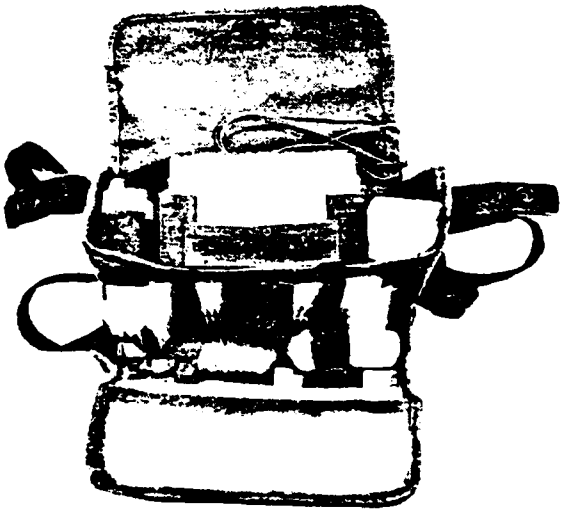
● The M256 Chemical Agent Detector Kit is issued to squad level. It can detect dangerous vapor concentrations of all known nerve, blister, and blood agents. It can also detect residual surface contamination. Detailed operating instructions are contained in the kit. The kit is used when the unit is under chemical attack, when a chemical attack is reported to be imminent, or when the presence of chemical agent is suspected. See TM 3-6665-307-10 for further information on this kit.

● The ABC-M18A2 chemical agent detector kit is issued to the headquarters and headquarters company of the battalion (Figure B-11), when there is an assigned chemical NCO to operate the kit. It can detect dangerous vapor concentrations of all known nerve, blister, blood, and choking agents. It can also detect residual surface contamination. Detailed operating instructions are contained in the kit. See TM 3-6665-254-12 for further information on this kit.

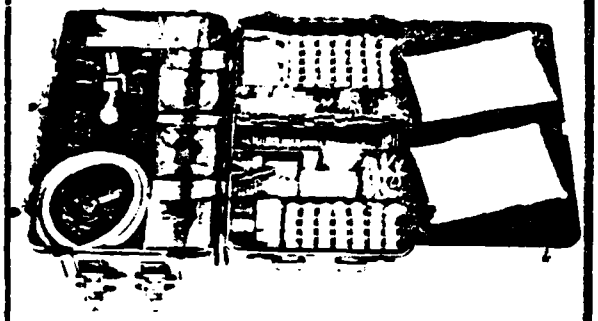
● The M19 CBR agent sampling and analyzing kit (Figure B-10) is intended for use by specially trained personnel in a technical intelligence team, a military intelligence team, or a chemical service organization to detect and identify enemy chemical agents; perform preliminary processing of chemical, biological, or radiological samples unidentifiable in the field for forwarding to chemical or medical laboratories; and to delineate contaminated area. This kit is capable of detecting and identifying types of known chemical agents in vapor, aerosol, liquid, and solid form. It is also capable of analyzing and identifying samples of chemical agents forwarded in the white-band sampling tubes from the M18A2 Kit. Details on this kit are found in TM 3-6665-205-10/1.

● The M34 CB agents sampling kit (Figure B-10) is available (CTA 50-970) to any headquarters having a chemical staff element or section, such as brigade and higher. This kit is used by chemical personnel to take sample of soil, surfaces, and water suspected of containing CB agent contamination. The personnel using the kit then process the samples according to the SOP of the command. This SOP will normally specify that samples from brigade, division, and corps will be sent to the nearest CBR agent sampling and analysis team (TOE 3-500). At Army level chemical agent and radioactive material samples are sent to the military intelligence company, technical intelligence, or the general laboratory specified by the theater SOP.

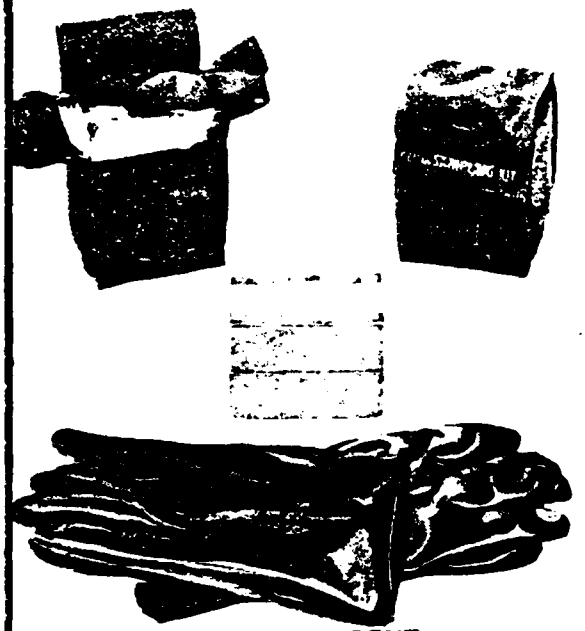
DETECTION AND SAMPLING KITS



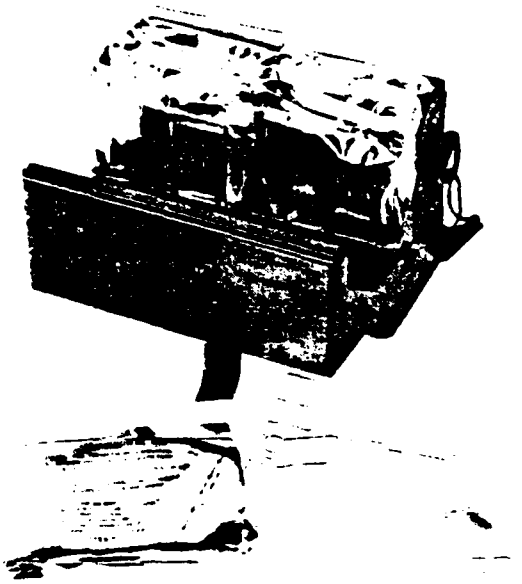
ABC M18A2 CHEMICAL AGENT DETECTOR KIT



ABC M19CB AGENT SAMPLING AND ANALYZING KIT



M34CB AGENT SAMPLING KIT



M256 CHEMICAL AGENT DETECTOR KIT

Figure B-10

RADIAC INSTRUMENTS

The standard radiac instruments used to detect and measure radioactivity are illustrated in Figure B-11 These instruments are normally authorized by a unit's TOE.

● *Dose-Rate Meters.* Dose-rate meters are electronic devices designed to measure the dose rate of radioactivity and display the rate, usually on a meter dial to the operator.

1 The standard ion-chamber radiacmeter IM-174A/PD is used for area monitoring and survey. It is a high-range dose-rate meter; gamma radiation readings are indicated in units from 0 to 500 rad/hr. It is normally issued on the basis of one per platoon-size unit. This meter is scheduled to soon be replaced by the radiacmeter IM-174B/PD, which is a modification of the IM-174-A/PD. TM 11-6665-232-12 contains information on the radiacmeter IM-174-A/PD.

2 The radiac set AN/PDR-27(*) contains a low-range dose-rate Geiger-Mueller (G-M) type instrument used for monitoring personnel, food and equipment. It is issued on the basis of one per divisional company-size combat and combat support unit and as required for medical, maintenance, and bath units and for water supply points. See TM 11-6665-209-15 and TM 11-6665-230-15 for details on these radiac sets.

(*)-Indicates all models of the series.

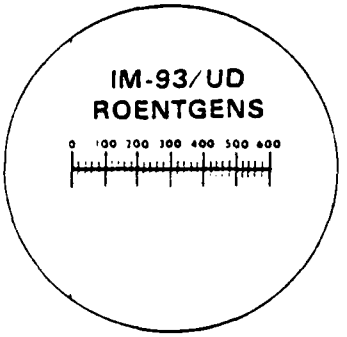
● *Dosimeters.* Dosimeters are devices designed to measure the total nuclear radiation (gamma) dose received by an individual. Dosimeters must be recharged after not more than 2 or 3 days of use (preferably everyday) and when the total dose reaches or exceeds 500 rad on the scale. Recharging times normally are designated in the unit SOP.

1 The standard tactical dosimeter, the IM-93 (*)/UD, is a self-indicating (direct reading) pocket dosimeter. Normally it is issued on the basis of two per platoon size-unit (with two spares in the company headquarters). If elements of a platoon-size unit operate separately under conditions to warrant it, a wider issue of dosimeters may be made. TM 11-6665-214-10 contains information on this item.

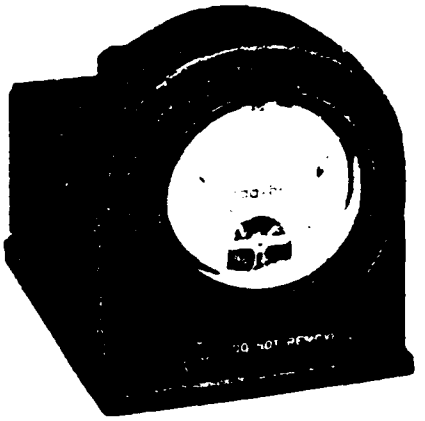
(*)-Indicates all models of the series.

2 The radiac detector chargers PP-1578/PD and PP-1578A/PD are used to charge the IM-93 (*)/UD dosimeter. They are issued on a basis of one per four dosimeters, but no more than five nor less than two per company-size unit. TB SIG 226-8 contains information on these chargers.

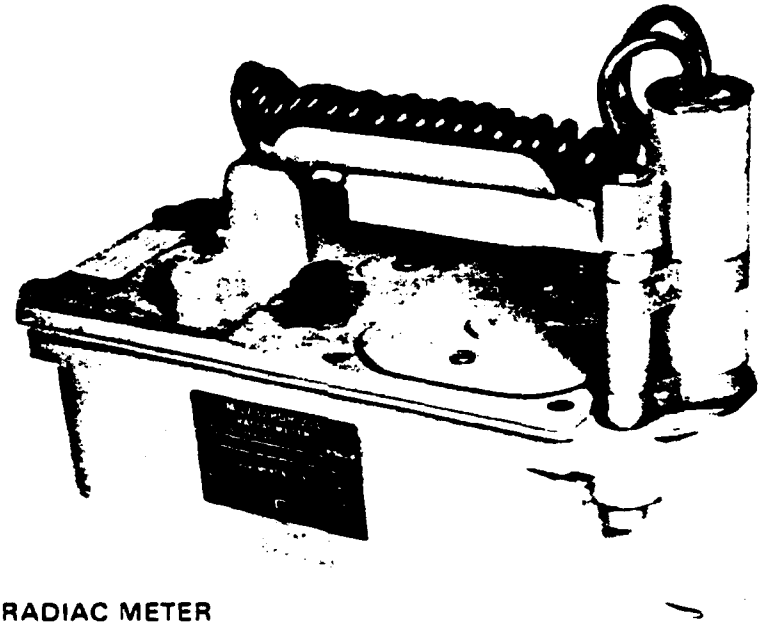
RADIAC INSTRUMENTS



IM93()/UD
DOSIMETER



IM-174A/PD RADIACMETER



G-M TYPE RADIAC METER
OF AN/ PDR-27() RADIAC SET

Figure B-11

TOPIC THREE TEST QUESTIONS

MARKING OF CONTAMINATED OR DANGEROUS LAND AREAS

UNIT 1

MARKING OF CONTAMINATED OR DANGEROUS LAND AREAS

(Task 942-999-9068)

General Situation: You have been told to scout out and report about an area suspected of being contaminated or containing dangerous land areas. To perform your mission satisfactorily you will need to be able to correctly answer the following questions:

1. The signs indicating radiological, biological and chemical contamination; chemical minefields; boobytraps; and unexploded munitions are what shape?
   A. Right isosceles triangle hung point down (long side down)
   B. Rectangle
   C. Octagon (shaped like a "stop" sign)
   D. The shape depends upon the type of contamination or dangerous land area
   E. Right isosceles triangle hung point up (long side up)
2. All markers always have which of the following characteristics?
   A. The type of contamination or dangerous area is printed on the side of the marker facing away from the contamination (front)
   B. The markers are identified only by color and shape
   C. The type of contamination or dangerous area is printed on both sides of the marker
   D. None of the above
3. A marker for chemical contamination has which of the following characteristics?
   A. Is yellow with the word "CHEMICAL" placed on it
   B. Is yellow with the word "GAS" placed on it
   C. Is red with a horizontal white four centimeter strip painted on it
   D. Is blue with the word "GAS" placed on it
   E. Is white with the word "CHEMICAL" placed on it
4. A marker for a chemical minefield has which of the following characteristics?
   A. Is red with a yellow stripe - no words on it
   B. Is red, has the words "GAS MINES" in yellow and a horizontal yellow stripe underneath the lettering
   C. Is white - no words or stripes
   D. Is blue with the words "MINES" on it - yellow stripe underneath the lettering
   E. None of the above

5. The marker for unexploded munitions has which of the following characteristics?

   A. Is yellow with red stripe - no words
   B. Is red with white stripe - no words
   C. Is red with the word "BOMB" placed on it
   D. Is yellow with a white bomb painted on it
   E. Is red with a white bomb painted on it

6. What additional information is commonly placed on chemical or biological markers?

   A. The size of the contaminated area
   B. The name of the organization who placed the marker
   C. The name of the agent, if known, and the date and time of detection
   D. All of the information above
   E. None of the information above

GO TO QUESTION 7, UNIT 2

UNIT 2

USE STANDARD-A CHEMICAL PROTECTIVE OVERGARMENT ENSEMBLE

(Task 957-999-8053)

General Situation: You are in a combat area in which chemical agents are present. You have just put on the Standard-A Chemical Protective Overgarment ensemble.

7. Which statement below is most correct concerning the Standard-A Chemical Protective Overgarment ensemble?

   A. It is expendable and is discarded within one week after being contaminated with liquid chemical agents or when it becomes worn or ripped

   B. It is reuseable and should be laundered or decontaminated within 24 hours after being contaminated with liquid chemical agents

   C. It is expendable and is discarded within 24 hours after being contaminated with liquid chemical agents or when it becomes worn or ripped

   D. It is expendable and is discarded within 6 hours after being contaminated with liquid chemical agents or when it becomes worn or ripped

   E. It is reuseable and should be laundered or decontaminated within 6 hours after being contaminated with liquid chemical agents

GO TO QUESTION 8, UNIT 3

UNIT 3

USE M-17 SERIES CHEMICAL, BIOLOGICAL FIELD PROTECTIVE MASK AND CB PROTECTIVE MASK CARRIER

(Task 666-777-8888)

General Situation: You are in a combat area in which chemical agents are present. You have just put on the M-17 series chemical, biological field protective mask.

8. The M-17 series chemical, biological field protective masks when fitted properly give protection against field concentration of all known enemy chemical agents in vapor or aerosol form by filter elements fitted into the mask. Where are these filter elements located?
   A. In the voicemitter of the facepiece
   B. Below the voicemitter of the facepiece
   C. One in each cheek of the facepiece
   D. In a pack that is worn on the chest and is connected by a tube to the protective mask

9. Which statement below is incorrect?
   A. The mask produces oxygen when there is a low oxygen content in the air
   B. The mask provides protection against carbon monoxide
   C. The mask provides protection against ammonia vapors
   D. All of the statements in A, B, and C are incorrect
   E. None of the statements in A, B, and C are incorrect

10. When should filter elements for the M-17 series chemical, biological field protective mask be replaced?
   A. After initiation of chemical warfare and at least once every 30 days thereafter
   B. After initiation of chemical warfare and at least once every week thereafter
   C. They do not need to be replaced unless they get wet
   D. After initiation of chemical warfare and at least once every 24 hours thereafter

11. Which item below is not carried in the CB Protective Mask Carrier?
   A. M-13 decontaminating and reimpregnating kit
   B. A book of chemical agent detector paper
   C. Nerve agent antidote injectors
   D. First Aid Kit
   E. Amyl nitrite ampuls

GO TO QUESTION 12, UNIT 4

UNIT 4

USE ABC M-13 INDIVIDUAL DECONTAMINATION AND REIMPREGNATING KIT, THE M258 SKIN DECONTAMINATING KIT, CHEMICAL AGENT DETECTOR KITS, AND CHEMICAL DEFENSIVE ITEMS

(Task 000-111-2222)

General Situation: You are in a combat area in which chemical agensts are present. You have with you appropriate decontamination and reimpregnating kits and detectors and defensive items.

12. Which item below is included in the ABC-M-13 Individual Decontamination and Reimpregnating Kit?
    A. Single-edge cutter
    B. Nerve agent antidote injectors
    C. Dosimeter
    D. First Aid Kit
13. On what item(s) of equipment/body part is the small decontaminating pad (skin pad) usually used?
    A. Weapons
    B. The inside of the protective mask facepiece
    C. Foot gear
    D. Hands
    E. All of the above
14. What is the major use of the single-edge cutter which is found in some decontaminating kits?
    A. Used for cutting brush in your immediate area that may be contaminated
    B. Used for opening chemical packets of decontamination agents
    C. Used to cut out spots of heavy contamination on clothing
15. What is the major use of the metal spike found in the M258 skin Decontaminating Kit?
    A. Used for puncturing the decontamination solution containers
    B. Used for digging a hole in which contaminated gauze pads are buried after use
    C. Used for scraping thick contamination jelly off the skin surface

16. The Chemical Agent Detector Paper, ABC, is effective in which of the following situations?
    A. For detecting chemical agents in both a liquid and vapor form
    B. For detecting chemical agents in a liquid form
    C. For detecting chemical agents in a vapor form
    D. For detecting chemical agents in liquid, vapor and/or solid form
    E. For detecting chemical agents in a solid form
17. The M19 CBR agent Sampling and Analyzing Kit is intended for use:
    A. By any Headquarters having a chemical staff element or section, such as brigade and higher
    B. At the squad level
    C. By specially trained personnel in a technical or military intelligence team, or by a chemical service organization
    D. By the individual soldier
18. To take samples of soil, surfaces and water suspected of containing CB agent contamination, the proper equipment is:
    A. The ABC - M18A2 Chemical Agent Detector Kit
    B. The M34 CB agents Sampling Kit
    C. The M19 CBR agent Sampling and Analyzing Kit
    D. The M256 Chemical Agent Detector Kit
19. Which of the following method is the most effective for applying Vesicant Gas Resistant, M2, leather dressing?
    A. Wipe-on method
    B. Hot-dip (immersion) method
    C. Spray method
    D. Cold-dip (immersion) method
20. The M256 Chemical Agent Detector Kit that is issued to squad level can detect which of the following agents?
    A. Blood agents
    B. Blister agents
    C. Nerve agents
    D. All of the above

END OF TEST

ANNEX C

EXIT QUESTIONNAIRE

NAME _____

DATE _____

EXIT QUESTIONNAIRE

TAR/SS/TT

Please give us your opinion of the computer system and the instructional materials.

Please be as frank as you want.

A. Button Box

I pressed the correct button on the first try.

Always	Mostly	Sometimes	Rarely	Never

B. Joystick

1) When I used the joystick to see slides on the color monitor I easily got what I wanted.

2) When I used the joystick on the data plane, I could easily move to the box I needed.

Always	Mostly	Sometimes	Rarely	Never

C. Color Monitor

1) Pictures were sharp and clear.

2) Drawings were sharp and clear.

3) Printing and writing were sharp and clear.

4) Voices were clear and distinct.

Always	Mostly	Sometimes	Rarely	Never

D. Black/White Monitor

1) Letters and words were sharp and easy to read.

2) The screen had too many words on it for easy reading.

Always	Mostly	Sometimes	Rarely	Never

3) Looking back and forth between the color monitor and the black/white monitor was:

___ Easy, no problem

___ A little confusing

___ Somewhat confusing

___ Very confusing and distracting

E. Study Room

1) Room lighting was:

___ Too dim

___ OK

___ Too bright

2) Background noise was:

___ Very low - I didn't even notice it.

___ Noticeable, but didn't interfere with my work.

___ Somewhat loud - I had to concentrate to ignore it.

___ Very loud - frequently distracted me from my work.

F. Computer Materials

	Always	Mostly	Sometimes	Rarely	Never
1) On the black/white monitor the instructions and directions were easy to understand.					
2) When the black/white monitor gave me a choice of buttons to push, I understood what each button would do.					
3) On the data planes, box labels clearly indicated what the boxes contained.					

The Color Monitor showed scenes in which positive self-talk was demonstrated.

The techniques demonstrated were:	Always	Mostly	Sometimes	Rarely	Never
4) Realistic, believable					
5) Meaningful to me					
6) Easy to understand					
7) Easy to imitate					
8) Easy to apply during practice					

The people who gave the demonstrations:	Always	Mostly	Sometimes	Rarely	Never
9) Were like people I have known					

The color monitor showed scenes where you could practice the positive self-talk .

These practice situations were:	Always	Mostly	Sometimes	Rarely	Never
10) Realistic, believable					
11) Meaningful to me					
12) Useful, helpful					

The Color Monitor showed scenes in which relaxation techniques were demonstrated.

The techniques demonstrated were:	Always	Mostly	Sometimes	Rarely	Never
13) Realistic, believable					
14) Meaningful to me					
15) Easy to understand					
16) Easy to imitate					
17) Easy to apply during practice					

The people who gave the demonstrations:	Always	Mostly	Sometimes	Rarely	Never
18) Were like people I have known					

The color monitor showed scenes where you could practice the relaxation techniques.

These practice situations were:	Always	Mostly	Sometimes	Rarely	Never
19) Realistic, believable					
20) Meaningful to me					
21) Useful, helpful					

The Color Monitor showed scenes in which study-skills were demonstrated.

The techniques demonstrated were:	Always	Mostly	Sometimes	Rarely	Never
22) Realistic, believable					
23) Meaningful to me					
24) Easy to understand					
25) Easy to imitate					
26) Easy to apply during practice					

The people who gave the demonstrations:	Always	Mostly	Sometimes	Rarely	Never
27) Were like people I have known					

The color monitor showed scenes where you could practice the study-skills .

These practice situations were:	Always	Mostly	Sometimes	Rarely	Never
28) Realistic, believable					
29) Meaningful to me					
30) Useful, helpful					

The Color Monitor showed scenes in which test-taking strategies were demonstrated.

The techniques demonstrated were:	Always	Mostly	Sometimes	Rarely	Never
31) Realistic, believable					
32) Meaningful to me					
33) Easy to understand					
34) Easy to imitate					
35) Easy to apply during practice					

The people who gave the demonstrations:	Always	Mostly	Sometimes	Rarely	Never
36) Were like people I have known					

The color monitor showed scenes where you could practice the test-taking strategies.

These practice situations were:	Always	Mostly	Sometimes	Rarely	Never
37) Realistic, believable					
38) Meaningful to me					
39) Useful, helpful					

G. Written Materials

While you were learning about positive self-talk you did some exercises on paper to help you recognize the difference between positive and negative self-talk, and to help you change your own negative self-talk to a more positive kind.

These offline exercises:	Always	Mostly	Sometimes	Rarely	Never
1) Were clear and understandable					
2) Seemed to be realistic					
3) Were useful to me					

While you were learning about relaxation you were given written instructions and an audio tape to help you practice relaxation at home.

4) I used these materials at home (check one)

___ Everyday for 30 minutes or more

___ Everyday for 15-30 minutes

___ Everyday for less than 15 minutes

___ 3 or four days during the week

___ Once or twice

___ Never

How often do you think you'll use the test anxiety reduction skills in the future?

	A Lot	Occasionally	Rarely	Never
5) Relaxation				
6) Positive self-talk				

G. Written Materials

You also had some paper and pencil study skills practice. (Where you read some paragraphs, made up questions, and highlighted answers)

	Always	Mostly	Sometimes	Rarely	Never
7) The paper and pencil materials were clear.					
8) I could apply the study techniques easily.					
9) The materials were useful for practice.					

How often do you think you'll use the study skills and test-taking strategies in the future?

	A Lot	Occasionally	Rarely	Never
10) Study skills				
11) Test taking strategies				

H. Military Manuals

You were asked to study and take a test on each of three different military topics: common emergencies, first aid in a toxic environment, and various equipment used for protection against chemical/biological agents.

How hard was it to study the topic materials?

	Very Hard	Somewhat Hard	A Little Bit Hard	Somewhat Easy	Very Easy
1) First aid in toxic environment					
2) Common emergencies					
3) Chemical/biological protection					

Check your opinion of the 1½ hour study times.

	More Than Enough Time	Enough Time	Too Little Time
4) First aid in toxic environment			
5) Common emergencies			
6) Chemical/biological protection			

Check your opinion of the 30 minute testing time.

	More Than Enough Time	Enough Time	Too Little Time
7) First aid in toxic environments			
8) Common emergencies			
9) Chemical/biological protection			

I. The SDMS System

I found that learning how to use the SDMS was (check one)

___ Very easy
___ Fairly easy
___ Somewhat hard
___ Very hard

J. The Proctors

I found the Proctors to be (check one)

___ Very helpful
___ Somewhat helpful
___ Somewhat unhelpful
___ Very unhelpful

K. General Feelings

1) The <u>most</u> valuable part of the course was:

_____

_____

_____

_____

2) The <u>least</u> valuable part of the course was:

_____

_____

_____

_____

APPENDIX C

AN ANALYSIS OF SIX MAJOR MICROCOMPUTERS:

Technology Transfer of the Spatial Data Management System for Basic Skills Education

by

Judith Parris

Prepared for

Human Resources Research Organization
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July 1984

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INTRODUCTION

This report analyzes and evaluates six major microcomputer systems for their potential transfer into the field as part of a computer-based educational system for Army soldiers. The principal use for which the systems are evaluated is as a vehicle for implementing the Spatial Data Management System (SDMS) for basic skills education. However, much more general comparisons are made, and the systems are evaluated according to their ability to perform in several management, analytical, and educational applications. The thrust of this report will be on a technical comparison of the hardware and software of the microcomputers. These microcomputers were selected because of their popularity as demonstrated by the number of units sold to private industry and the military through 1982. All of these systems have been purchased and used by civilians and U.S. Army officials although the Commodore 64 and Cromemco somewhat less.

The following six systems were evaluated in the analysis:

1. Apple II
2. Commodore 64
3. Cromemco
4. IBM Personal Computer
5. Osborne 1
6. Radio Shack

The emphasis of this comparison is on their particular hardware and software characteristics and their potential for user (U.S. Army) acceptance or rejection. All components of a microcomputer system--hardware, operating systems, programming languages, applications software, instructional courseware, and documentation--are critical in an analysis of a computer system. The overall ability of a particular system to meet the computing needs of a potential user depends on the specific nature of the applications for which the system will be used, as well as the preferences of the user. Thus the ultimate evaluation of a microcomputer system requires the judgment of the user. It is hoped that this report can aid potential users at reaching informed judgments.

A particular concern in this evaluation is the ability of the computer system to support the Spatial Data Management System (SDMS) for basic skills education. SDMS is a concept by which diverse data bases are organized according to a hierarchical structure which is presented to the user spatially, in a series of two-dimensional "data planes." The data bases may reside on a number of storage devices, including magnetic disk, optical videodisc, and microfiche reader. Originally developed for the Defense Advanced Research Projects Agency (DARPA) by the Architecture Machine Group at the Massachusetts Institute of Technology (Bolt, 1979), SDMS has been modified to operate on off-the-shelf equipment by Interactive Television Company (Levin, 1980). This microcomputer-based system will be considered in the evaluation of the microcomputer systems.

The SDMS does not present very severe requirements on the features which a candidate microprocessor must possess. The processor must be able to control the videodisc and must accept inputs from a joystick and control buttons. All systems considered have sufficient ports to handle this level of communication, although for some systems, the interfaces may only be obtained at extra cost. Other features of the system, such as processor speed and amount of memory, appear adequate in all tested systems. Display of the hierarchical "dataland" is facilitated if the system allows display of a full 80-character screen width, a problem with one of the systems. All things considered, it would be possible to implement SDMS on any of the six microcomputer systems.

It should be noted that this report is intended to serve as an informal guide to making recommendations on the selection of a microcomputer system for U.S. Army use, as well as an aid to the transfer of the Spatial Data Management System to basic skills education.

METHOD

The review and analysis contained in this report was based upon the following:

1. Hands-on experience with each microcomputer system, including setup and installation, maintenance requirements, and practical use of major software packages (electronic spreadsheet, word processing, database management, operating systems, programming languages, and other standard software); and

2. Completion of a Checklist Report Card for each microcomputer system.

The analysis and review of each microcomputer system addresses four major areas of concern in addition to concluding remarks:

1. Hardware
2. Software
3. Documentation
4. Maintenance and Serviceability

The hardware section discusses the physical components of the system including memory, microchips, RAM, ROM, cabinetry, circuitry, and ports. In addition, operability, dependability, ease-of-installation and setup are addressed. Overviews of the hardware and memory storage capabilities across the six microprocessors are presented in Tables C-1 and C-2.

The software section focuses on the number and types of packages available for each system. When evaluating software there are at least four key points to consider:

Table C-1. Hardware

COMPUTER SYSTEM	PRICE	ENCLOSURE	CPU		BUS	TERMINAL
			TYPE	BITS		
Apple Computer						
II	2,175	Tabletop	6502	8	prop	1/1
III	3,940	Tabletop	6502B	8	prop	1/1
Cromemco						
System 1	3,995	Tabletop	Z80A	8	S-100	none/3
System 3	7,995	Rack Mtd or Built in	Z80A	8	S-100	none/6
Commodore						
64	595	Tabletop	6510	8	none	1/1
IBM	3,045	Tabletop	8088	8/16	S-100	1/1
Osborne 1	1,895	Tabletop	Z80A	8	none	1/1
Radio Shack						
TRS-80 II	3,499	Tabletop or Built in	Z80A	8	prop	1/1
TRS-80 III	2,495	Tabletop	Z80A	8	prop	1/1
TRS-80 16	5,798	Tabletop or Built-in	Z80A, MC68000	16/32	prop	1/2

Table C-2. Memory Storage

COMPUTER SYSTEM	MEMORY (RAM) K		FLOPPY DISK Kb	
	Standard	Maximum	Standard	Maximum
Apple Computer				
II	48	64	170	340
III	128	256	140	280
Cromemco				
System 1	64	512	780	3,260
System 3	64	512	2,400	4,800
Commodore				
64	64	64	170	170
IBM PC	64	10MG	160	320
Osborne 1	64	64	204	408
Radio Shack				
TRS-80 II	64	64	416	1,870
TRS-80 III	48	48	368	736
TRS-80 16	128	512	2,500	5,000

1. Software should be free of technical errors.

2. The software should take advantage of the machine's unique capabilities without substituting flash for substance.

3. Software for computer-assisted instruction should be creative and should stimulate creativity, allow easy teacher modification, provide positive reinforcement while helping students to understand wrong answers, and include some diagnostic and branching features.

4. Clearly written documentation (support) materials and activities should accompany the software package.

General remarks describe software packages according to their ease of use, transportability, and usefulness. Software is the major force of the personal computer industry. The more frequently-cited applications by both current and potential users of personal computers are word processing, games, education, graphics, and recordkeeping. Typically, the more successful (greatest user acceptance) microcomputer systems are those having superior software packages available at the lowest cost. Applications and systems software are summarized in Tables C-3 and C-4 for the six microprocessors.

Documentation refers to the quantity and quality of manuals, tutorials, and other supporting materials supplied with hardware and software. The ease of operation tends to be an important concern for both experienced and potential computer users.

Lastly, the section on Maintenance and Serviceability discusses the issues of care, service, and parts replacement. This is an important section since microcomputers are now being installed in locations where technical know-how, point-of-sale support, and replacement parts are not readily available. There is no industry-wide standard service policy for small computers. Most computer stores offer maintenance for the computers that they sell, but most are also reluctant to discuss turnaround time for repairs.

A study, The Personal Computer Industry II: A Strategic Analysis, by the Venture Development Corporation (Wellesley, Massachusetts) ranked factors influencing purchase of personal computers by potential industry and business users. Potential personal computer users ranked maintenance and service third, while current users ranked this factor thirteenth (see Table C-5). According to potential microcomputer users, reliability was the most important factor in selecting a system.

The second method of analysis required the development and preparation of a preliminary Checklist Report Card. Developed as an informal analysis tool for the evaluation of these six microcomputer systems from the user's perspective, this Checklist reflects concern for human factors, user-friendliness, maintenance, dependability as well as learning and knowledge requirements. A sample Checklist Report Card can be found in the Annex.

Table C-3. Applications Software

COMPUTER SYSTEM	SPREAD-SHEET	WORD PROCESSING	DBMS	OTHERS
Apple				
II	none	opt	opt	Games, Videotex, Graphics, Education, Voice Recognition, Data Processing, Business, Videodisc Communications, Electronic Mail, etc.
III	opt	opt	none	
Cromemco				
System 1	opt	opt	opt	Hi-Res Color Graphics, Business
System 3	opt	opt	opt	Same as above
Commodore				
64	opt	opt	opt	Hi-Res Color Graphics Music, Education, Games, Music, Communications, etc.
IBM	opt	opt	opt	Voice Recognition, Education, Music, Electronic Mail, Data Processing, Business, Videotex, Communications, Videodisc, Hi-Res Color Graphics, etc.
Osborne 1	std	std	std	Graphics, Communications
Radio Shack				
TRS-80 III	opt	opt	opt	Communications, Graphics Education, Electronic Mail, Data Processing Videotex, Business, etc.
TRS-80 II	opt	opt	opt	
TRS-80 16	opt	opt	opt	

Legend: Opt - Optional; Std - Standard

Table C-4. Systems Software

COMPUTER	OPERATING SYS. Single	Multi	PROGRAMMING LANGUAGES ASSEMBLER	BASIC	COBOL	FORTRAN	PASCAL	OTHER
Apple								
II	DOS	none	opt	std	none	opt	opt	PILOT & LOGO
III	SOS	none	none	std	none	none	opt	none
Cromemco								
1 3	opt	opt	opt	opt	opt	opt	none	LISP & RAFFOR
Commodore								
64	CP/M	opt	opt	std	opt	opt	opt	PILOT & LOGO
IBM	DOS P-System CP/M	none	none	std	opt	opt	opt	PILOT & LOGO
Osborne 1	CP/M	none	std	std	none	none	none	FORTH
Radio Shack								
II	TRSDOS	none	opt	std	opt	opt	none	opt
III	TRSDOS	none	opt	std	opt	opt	opt	Micro Pilot & Author I
16	TRSDOS	opt	std	std	opt	opt	none	opt

Table C-5. Ranking of Factors Influencing Purchase by Business Users and Potential Business Users of Personal Computers

	Users	Potential Users
Low Hardware Cost	1	9
Ease of Expansion	2	5
Ease of Programming	3	2
Ease of Interfacing	4	7
Reliability	5	1
Ease of Operation	6	4
Documentation	7	8
Manufacturer's Reputation	8	6
Application Support/Availability	9	12
Input/Display Capabilities	10	11
Speed/Performance	11	15
Customer Support	12	10
Maintenance and Service	13	3
Communications Capability	14	13
Size/Compactness	15	16
Portability	16	18
Better Warranty	17	14
Training	18	17
Contract/Financial Arrangements	19	19

Source: Venture Development Corp.

RESULTS

The following subsections describe the six candidate microcomputer systems. An overview of the results can be determined by examining the results of the Checklist Report Card, shown in Figure 1. Figure 1 shows that the IBM PC receives the most favorable rating. The only two areas in which the IBM did not receive a favorable rating were in the consistency and simplicity of the software; even in this area, the system was only slightly faulted.

Other systems are faulted on a variety of factors. The Commodore 64 and Osborne 1 are rated favorably on almost all factors. The major problems identified by the ratings of the Commodore are in the ease with which it is learned and the extent to which the software maintains the users orientation to the task. For the Osborne, the major faults were in the availability of training, and the knowledge required to use the system. The Radio Shack computers, also were rated relatively favorable, although slightly less so than the Osborne and Commodore.

Quite a few problems were identified by the Checklist for both the Cromemco and the Apple II. For the Cromemco, the problems were mainly associated with reliability of the hardware, and the difficulty of obtaining service. The Apple exhibited problems in system and software consistency, memory demands, ease of setup, training, and ease of use and simplicity of the software. Detailed descriptions of the systems are given in the following subsections.

Apple Computer

The Apple II is one of the oldest entries, as well as one of the most popular, in the personal computer field. Although the processor and operating system for the Apple II are not compatible with other systems, there is a great amount and variety of software which has been developed for the Apple, and a large sales and service network. In addition, a different processor may be purchased for the Apple which allows it to run much of the commercially-developed software written for other machines.

Hardware. The Apple microcomputer is modular, and each of its components is replaceable. The Apple microcomputer can be purchased separately, or as a package with a black and white (or color) monitor, one or two floppy disk drives, printer, joystick, lightpen, touch-sensitive screen, and speech box. It is conceivable that users might want to purchase extra parts. Modular systems tend to be more cost-effective than stand-alone, tabletop systems.

Both the Apple II and III are 8-bit machines. The central processing unit (CPU) of the Apple II is the 6502 microchip, and for the Apple III it is the 6502B. Neither of these chips are strong and widely accepted standards in the computer industry. The use of these chips is a principal reason that much of the circuitry and operating software for both the Apple II and III is incompatible with practically every other microcomputer on the market. This issue will be discussed in greater detail in the Software section.

CHECKLIST REPORT CARD	Apple II	Commodore 64	Cromemco	IBM-PC	Osborne 1	Radio Shack
Is the system forgiving when you make a mistake?	No	Yes	Yes	Yes	Yes	No
Is the hardware system dependable?	Usually	Yes	No	Yes	Yes	Yes
Is the hardware system physically convenient (e.g. is it easy to move)?	Yes	Yes	No	Yes	Yes	No
Are manuals and computer-based tutorial aids up-to-date?	Yes	Yes	Yes	Yes	Yes	Yes
Is training continually available?	No	Yes	Yes	Yes	No	Yes
Do you have a sense of closure when you have completed a task?	Yes	Yes	Yes	Yes	Yes	Yes
Does the software help avoid confusion?	Sometimes	Yes	Yes	Yes	Yes	Usually
Are software rules consistent?	No	Yes	Yes	Yes	Yes	Yes
Are software rules easy to learn?	No	Sometimes	Yes	Yes	Yes	Sometimes
Does the system expect you to know a lot about it before you use it?	Yes	No	No	No	Yes	Yes
Are software commands logical and self-evident most of the time?	No	Yes	Yes	Yes	Yes	Yes
Does the software keep you constantly oriented to your task?	Sometimes	No	Yes	Yes	Yes	Yes
Are computer graphic displays neat, clean, and simple to follow?	Yes	Yes	Yes	Yes	Yes	Yes
Is the computer system easy to set up?	No	Yes	No	Yes	Yes	Yes

Figure 1. Checklist Report Card

CHECKLIST REPORT CARD	Apple II	Commodore 64	Cromemco	IBM-PC	Osborne 1	Radio Shack
Is computer system consistent?	No	Yes	Yes	Yes	Yes	Yes
Does the system make minimal demands on human memory?	No	Yes	Yes	Yes	Yes	Yes
Is the computer system documentation sufficient?	Yes	Yes	No	Yes	Yes	Yes
Is the system easy to service?	Yes	Yes	No	Yes	Yes	Yes
Does the computer software provide appropriate feedback?	Sometimes	Yes	Yes	Yes	Yes	Yes
Is the software consistent?	Yes	Yes	Yes	Usually	Yes	Usually
Is the software simple?	No	Yes	Yes	Usually	Yes	Usually
Is the software easy to learn?	No	Yes	Yes	Yes	Yes	Usually
Is the computer software documentation sufficient?	Sometimes	Yes	Sometimes	Yes	Yes	Yes
Does the program and system match your skill level?	Sometimes	Yes	Yes	Yes	Yes	Yes
Does the system sustain your orientation to the system?	No	Yes	Yes	Yes	Yes	Yes
Do you know where to go to obtain the services of a qualified engineer to perform on-site maintenance?	Yes	Yes	Yes	Yes	No	Yes
Are there local places where the machine can be brought for service?	Yes	Yes	No	Yes	Yes	Yes
Must the machine be brought back to the factory for simple repairs?	No	Sometimes	Yes	No	No	No
Is there anything that the average non-technical person can do to keep repair costs down and efficiency up?	Yes	No	Yes	Yes	No	Yes

Figure 1. Checklist Report Card (continued)

The Apple II has a standard memory of 48K and a maximum memory of 64K. The Apple III's standard memory is 128K with a maximum capacity of 256K. A single floppy disk for the Apple II (single density), has a standard capacity of 170Kb and a maximum of 340Kb. This is more than the Apple III, which has a floppy disk standard capacity of 140Kb and a maximum of 280Kb.

Software. It is in the area of operating and program software packages that the experienced Apple user learns to appreciate the lack of a standard microchip. Most of the commercially available software packages are written for other microchips--Z80, Z80A, MC68000, 8088, 8086. Thus, most of Apple II and Apple III software is hardware-based requiring a substantial financial investment in a circuit board that has the proper microchip to enable the package to run properly on the system.

Consequently, in order to purchase a number of different software packages for the Apple, it is usually necessary that a circuit board (or controller interface card) also be purchased. Most of the popular software packages require the insertion of a circuit board thus increasing the complexity of each software package.

Operating systems for both the Apple II and III are also not industry standard. SOS, the operating system of the Apple III, cannot be used on any other microcomputer. Nor can the SOS be used on the Apple II machine. And, if the computer user wants to use a CP/M-based software package, it will be necessary to purchase a circuit board for installation in the machine.

There is, however, a wide variety of packages for the Apple II on the market today, considerably more than there is available for the Apple III. Software packages include communications, voice recognition and synthesis, learning and computer-assisted instruction packages as well as authoring languages such as Pilot, and games.

The Apple II is one of the few microcomputers capable of overlaying computer text and graphics onto a video image. This capability requires the purchase and insertion of an interface controller card into the main circuit board of the machine as well as a floppy disk.

Documentation. The manuals for the Apple II and III are poorly designed and not properly arranged or indexed. It is difficult to find out how to format a blank disk and the instructions are not well constructed. Again, the manuals are not written for the novice user. There are few software tutorials available for purchase.

Maintenance and Serviceability. There is a growing number of reliable and experienced computer stores available to repair the Apple microcomputer. Also, reasonably priced on-site maintenance contracts are available. Apropos of the widespread use of Apples and a network of reliable dealers, there is a low failure rate for Apple computer components. While some Apple retail outlets are, at best, vague about turnaround time and uncertain about hourly rates, other Apple retail outlets welcome inquiries into their service policies, and offer quick turnaround for most problems. Moreover, some of these Apple retail outlets not only state rates for service, but also estimate the time required for each type of problem.

Conclusion. Originally, the Apple II was designed as a computer for hobbyists—not for the novice computer user. Much of the Apple system can be considered a non-industry standard. In other words, much of the Apple's software and hardware is not transportable to any other microcomputer system. As discussed in the above sections, in order to use commercially available software packages that run on operating systems such as CP/M requires an investment in additional hardware (a specially designed circuit board). One of the problems with the requirement for additional hardware is that much of it is not built or marketed by Apple. The reliability and dependability of these add-ons are often poor and cause machine failure.

Many of these Apple software-hardware packages are not easy to install without some previous knowledge and experience on the part of the user. Thus, Apple microcomputers are generally experienced by novice users as not friendly, reliable, easy to operate or learn to use.

As a result of the need to purchase additional circuit boards to develop an Apple system capable of performing a variety of tasks, the computer tends to overheat. Cooling all the necessary boards is not easy even with the addition of a fan. Finally, the Apple microcomputer can be very sensitive to voltage irregularity.

Commodore 64

The Commodore 64, introduced in 1982 as a microcomputer competitive with Apple, Radio Shack, and IBM, is a color computer that plays games, performs data processing, word processing, and number crunching as well as most major microcomputer systems. It is included in this review of systems because its features are very similar to those of widely accepted and popular machines on the consumer market today.

Hardware. The Commodore 64 is housed in a brown plastic cabinet that is 16 inches wide by 8 inches deep by 2-1/2 inches high. The full-size, typewriter-style keyboard has 66 keys including four function keys. If the Shift key is used, these four function keys become eight. The Commodore is a modular system. A monitor, modem, one floppy disk drive (or cassette), printer, or any other peripherals can be purchased separately.

The Commodore 64 is built around a 6510 microprocessor, which uses the same instruction set as the 6502 microchip but has additional input/output lines. The computer has 64K RAM on board, 39K available for built-in BASIC programs or 52K for machine-language programs. The operating system and the BASIC (version 2.0) language occupy 20K of ROM. Included in the computer is the 6581 chip known as a SID (Sound Interface Device) which produces three independent voices each with a range of 9 octaves. Four waveforms are available--pulse, sawtooth, triangle and noise. The ADSR (Attack time, Delay time, Sustain level and Release time) of each note created by a wave form generators are completely and independently programmable. The Commodore 64 also has an 8 bit user port that accepts an optional modem.

Each disk drive contains its own microprocesor and memory system and can accommodate 170K of data per drive. However, a cassette tape is a viable medium for the storage and retrieval of programs and data when speed is not important. However, a conventional cassette recorder with the standard input/output audio cables cannot be used. It is necessary to purchase a dedicated recorder from Commodore.

The video display is 40 columns by 25 lines. There are 255 combinations of boarder/background colors and it has 16 available colors that can be used simultaneously. A high-resolution Graphics mode is a grid of 320 x 320 pixels.

Software. As is the case with Apple, software packages for the Commodore 64 will be, in a number of instances, hardware-based. In other words, programs will be cartridges rather than floppy disk or cassettes. Packages for word processing, data base management and data processing are now available for the Commodore 64. BASIC is built into the machine. Software packages tend to be elemental and relatively limited in their functions. The programs such as the word processing packages are easy to learn. Since this is a new machine, it will be awhile until a sufficient amount of software becomes available. However, it is possible to install a Z80 processor, so that the Commodore 64 will run programs written to operate under CP/M.

Documentation. The user's guide is generally good but not particularly thorough. It does take the user step-by-step through most of the major areas of setup, BASIC programming, graphic commands, sprite graphics, creating sound, and data handling. However, the computer system does not include the Programmer's Reference guide which must be purchased separately.

If a floppy disk drive is used with the computer, the manual provides little useful value. The documentation provided makes it difficult to understand how to format a blank disk. Moreover, whatever information is in the manual concerning the floppy disk drive is inadequate and insufficient.

Certain operations, such as save/load operations from disk to computer, are slow. Also, it is necessary to delete or rename the old file before you can save the new version. Another problem is that so many of its programs use special keys that produce special characteristics that it is difficult for the average user to interpret a program from the printed page.

Maintenance and Serviceability. There is a 90-day warranty with every new machine. Most of the dealers for the Commodore 64 are department or high-fidelity stores. Some computer stores carry the Commodore which is generally perceived as a low-end computer system. Service contracts are not generally available. Maintenance can be delivered through the dealer or by returning the computer to the company.

Conclusion. The Commodore 64 is an inexpensive microcomputer which offers many of the features of more expensive computers, such as the Apple II. It is easy to set up and operate the system with little foreknowledge of the system. Overall, it is an excellent beginner's computer for home or school use. It is, however, not appropriate for business and industrial applications. The limitations of the Commodore are mainly in the areas of software availability and its minimal expansion capabilities. Its design precludes significantly

expanding the system's memory capacity, as well as the addition of other peripherals such as an extra monitor, lightpen, speech synthesizer, and videodisc player. However, the Commodore offers a great capability for its price, and can be considered a good computer for home use or for the novice user.

Cromemco Computer

Hardware. The Cromemco system is also a modular system but considerably less portable than any of the other microcomputers reviewed in this report. It includes two 8-inch floppy diskette drives housed in a bulky unit. A significant piece of furniture is necessary to support a Cromemco system as compared with the Commodore 64.

A Z80A 8-bit microchip, an industry standard microprocessor, forms the basis of the Cromemco system. The standard memory is 64K and can be expanded up to half a megabyte (512K). Because the Cromemco uses 8 inch floppy diskettes, it can store considerably more information without the need for a hard disk. The standard storage capacity of the 8 inch runs from 780K to 2,400Kb depending upon which system is used. The maximum floppy disk storage ranges from 3,260Kb to 4,800Kb.

The Cromemco uses a parallel interface card rather than a special-purpose controller card to interface to the videodisc player. (This is advantageous in terms of cost and ease of use.) In addition, the Cromemco computer has high resolution color graphics.

Software. The Cromemco is a high-end microcomputer hwich uses a slightly modified version of the S-100 bus. CP/M is not a standard Cromemco product, but their microcomputers will run the CP/M system. The S-100 bus is an "electronic highway" used by individual modules of a microcomputer to transmit information between each other. In theory, all microcomputers that use the S-100 bus have interchangeable electronics. The use of CP/M software controls the flow of data between the system's internal memory and external disks.

Cromemco has sophisticated software packages that are intended for use by experienced computer users. These packages tend to be business-oriented and special purpose, such as inventory, accounting, and data processing. The programming languages that run on the Cromemco are high-end (e.g., LISP and RATFOR).

The SDMS is one of the few examples of the application of the Cromemco computer for an education system.

Documentation. The manuals for the Cromemco System 1 and 3 are informative, and easy to use if the computer user is experienced. There are no tutorials (paper- or software-based) available for either system.

Maintenance and Serviceability. There are also few U.S.-based, foreign dealers, and service centers qualified to maintain and repair Cromemco microcomputers.

Conclusion. The Cromemco is a rugged business and special-purpose application microcomputer system. However, because of its size, the system is too bulky and difficult to move.

The Cromemco-based Spatial Data Management System has proven more fragile than originally thought when the SDM system was designed. The chips on the memory board are not soldered into the machine's motherboard and tend to "walk out" of their sockets. Periodically, the chips need to be pushed into the memory boards.

The Cromemco draws a lot of power, tends to overheat and is very sensitive to voltage irregularity. Since the S-100 bus system is highly modular and therefore larger, it requires additional power. The task to cool all the necessary boards is not easy.

IBM Personal Computer

The IBM Personal Computer marks the entry by the largest computer manufacturer into the microcomputer market. As such, it has generated substantial investment in software development by design firms as well as companies interested in manufacturing and marketing "plug-compatible" add-ons such as memory expansion units, lightpens, modems, graphic tablets, paddles, keyboards, and the like.

Hardware. The system unit is 20" x 16" x 5.5" and contains a built-in speaker for audio and music applications. This unit also has space for up to two disk drives (one drive can be a hard disk) and room for additional memory and other options stored on circuit boards.

The IBM Personal Computer is a high-speed, 16-bit microprocessor. 40KB ROM standard includes an easy-to-use BASIC. A large capacity permanent memory of some 41K and expandable user memory up to 10 megabytes is possible by the addition of a 10MG Winchester hard-disk drive. The user has a choice of storage device: a personal, standard audio-cassette recorder/player or one or two 5-1/4 inch floppy disk drives.

The system inlcudes detached, adjustable, 83-key typewriter-like keyboard with a 10-digit numeric calculator pad and special function keys for activating commonly repeated tasks. There is a choice of non-glare video display as well: a high resolution IBM or plug-compatible monochrome (or color) display, a standard TV monitor or a personal TV set with an RF modulator (this last item must be purchased separately). In addition, RGB monitors are also compatible with the IBM Personal Computer.

A built-in time-of-day clock i included. The system includes diagnostic capabilities that automatically check the system components including power-on self test and parity checking.

One or two 5-1/4 inch disk drives, either single or double density, are available. Each single-sided diskette has a 160Kb formatted capacity.

The IBM PC can provide users with a text system capable of displaying 256 different characters in any of 16 foreground and 8 background colors, in 40 or 80 columns, upper and lower cases. It is also capable of displaying graphics in four colors.

Software. The IBM PC comes with a Computer Disk Operating System (DOS) with Disk BASIC and Advanced BASIC. Other Operating Systems that run on the IBM include the UCSD p-system, CP/M86, and UNIX. Programming languages include FORTH, PASCAL, MBASIC, CBASIC, COBOL, FORTRAN, and MACRO, a machine language. Also, there are authoring languages for computer-assisted instruction including LOGO and PILOT.

On the market today, there are over 2,500 software packages in accounting systems, communications, word processing, games, learning and educational programs written for the IBM PC. In addition, there is a wide variety of programs for special purpose electronic spreadsheets, business graphics, database and records management, and computer-assisted instruction. Recently, integrated software packages for the IBM PC such as the Lotus 1-2-3 and Context MBA have been developed; and, NBI has created a professional word processing software for the IBM PC as well. However, the NBI and integrated software packages sometimes require the purchase of a circuit board because there is a requirement for additional memory (more than the base 64K) and/or special function software stored on a microprocessor.

Documentation. The documentation for installation and setup is excellent. Supporting manuals for software packages are well organized and easy to learn how to use. Diagrams included are well appointed. Each software manual is arranged as a tutorial for the newcomer. A variety of excellent and inexpensive tutorials are avaiable for purchase.

Maintenance and Serviceability. IBM is one of the few companies that have parts and labor price sheets. They offer extensions of their warranty, which guarantees that a user can bring the system in for repair any time during the covered period. For instance, maintenance contracts for IBM machines can now be purchased from Computerland and Entree.

Conclusion. It is apparent from recent studies on the IBM PC that its' human factors design is very positive. IBM has begun to put substantial emphasis on human factors design, and the IBM PC exhibits many positive results of the efforts of huyman factors specialists.

The IBM has become the most popular microcomputer on the market today. It is now the industry standard. It is a well-designed, attractive system which has incomparable hardware and software expansion capabilities.

Osborne 1

The Osborne 1 was the first portable, self-contained microcomputer system ever introduced. Designed for business and home use, it has paved the way for the development of a blossoming portable microcomputer industry.

Hardware. The Osborne 1 is approximately 9 inches high, 20.5 inches wide, and 13 inches deep. It is weatherproof, and the power cord can be stored in the case with a plastic panel with velcro strips, which also covers the power switch and the red circuit breaker. It weighs approximately 24 pounds.

A 69-key detachable keyboard with 12-key numeric keypad is connected to the main electronic module by a single cable. The system comes with two disk drives. One 5-1/4 inch single density floppy disk drive is mounted on either side of the diplay screen. Each disk drive provides 102,400 bytes of secondary storage. Double density operation is also available allowing the Osborne to store as much as 204,800 bytes.

The processor board uses the Z80A microprocessor. Mass memory consists of 60K bytes of user programmable memory and 4K bytes of ROM, which are bank switched.

The video display provides 32 lines of 128 characters per line. To accommodate the small video monitor (5 inches diagnonally) only 24 lines of 52 characters each can be seen at any one time. The user may scroll the screen both horizontally and vertically to look at any 24 line by 52 character portion of the total display window. Scrolling is accomplished by holding down the control key while simultaneously using one of the four arrow keys. If the user sits about 15 inches away from the screen, it is quite clear. Parts include an RS-232C and IEEE-488, and modem cable connectors.

Software. Included as standard software is the CP/M operating system, Wordstar (with Mailmerge), Supercalc, CP/M 2.2, CBASIC, and MBASIC. Also included are several useful utility programs. A number of programs were promised at the outset of the Osborne but few have actually become available. There are no computer-based instructional authoring languages for this system.

Documentation. Documentation for the Osborne 1 is excellent for the novice user. The manual begins by showing how to set up the computer and provides a tour of all its connectors, the video display, the keyboard, and the disk drives. It then explains how to handle floppy disks and how to boot the CP/M operating system.

There are no specially designed tutorials available for purchase for the Osborne 1. However, the manuals, similar to those designed for the IBM PC, can capably serve as tutorials.

Conclusion. A problem with the Osborne is the small video display. Usually, it is necessary to connect a large (9", 12", or 13") video display in order to comfortably use the machine. The smaller screen does not allow a full 80 column per line display. In addition, the Osborne has a stark "military" look which is not easy on the eye for long periods of time.

It has the best features of all the business computers, plus enough software to satisfy all but the most demanding of requirements. It is possibly the ideal business system for low-end applications. It is well-designed with a rugged all in one enclosure making it easy to move and set up.

The Osborne 1 was marketed as a portable machine. it is uncomfortable to carry it around for any significant period of time and although the advertisement says it can be fitted under an airplane seat, that is just not so. It is rather bulky and unwieldly at best with hard sharp edges.

Moreover, after a relatively small period of use, the cable cover connecting the keyboard to the main module becomes frayed and loose.

Radio Shack

Tandy Corporation was the first company to introduce a microcomputer during the late 1970's. At that time the Radio Shack microcomputer had little software available, no floppy disk drives (only casette interface), and no programming languages. Within 2-3 years of this product, the firm began to manufacture a microcomputer now widely accepted in the home and schools for educational and business applications.

Hardware. As compared with the other microcomputer systems discussed in this report, these microcomputers are stand-alone systems. In other words, the disk drives, keyboard and monitor are all encased in one cabinet. All machines have a full size typewriter-like 65 key keyboard with a 12-key numeric keypad for data entry.

The standard RAM memory for Radio Shack computers ranges from 48-128K; the maximum is 48-512K. The floppy disk drives can be either single or double density and have the standard capacity to store anywhere from 416Kb to 2,500Kb. The maximum memory storage on their floppy disk is 736-5,000Kb.

Both the TRS-80 II and III use 8-bit Z80A microprocessors. The Radio Shack 16 uses Z80A as well as the MC6800 microchips and can operate as a 16-32 bit machine. The Radio Shack 16 can function as a Model II and use Model II software. And, Model II users can upgrade their computers to include the Model 16's 16-bit processor.

Video displays for all the machines are 12" monitors and includes 96 text charaters, 64 graphics characters and 96 special characters. All machines include at least one internal RS-232C serial communications interface.

Software. The operating system used by each Radio Shack microcomputer is a customized DOS system called TRSDOS, incompatible with any other micro. BASIC is a standard programming language that accompanies each Radio Shack machine. There are a variety of CAI authoring languages including Micro PILOT, and Author I.

Radio Shack computers tend to be oriented towards the novice user and depending on the model, every machine uses ready-to-run software on either audiocassette tape, disk, or a plug-in Program Pak.

Documentation. Manuals are well-designed and also serve as tutorials to a limited degree. The manuals help assist the novice user along the way when first intalling the system. However, they assume a basic understanding of computers and some previous computer experience.

Maintenance and Serviceability. Like IBM, Radio Shack is one of the few firms that has parts and labor price sheets. They offer extensions of their warranty, which guarantees that a user can bring the system in for repair any time during the covered period. There is an extended service plan that offers priority response to service needs and protection against surprise repair bills. There are over 200 Service Centers nationwide with trained technicians.

Conclusion. One of the problems with the Radio Shack is that to increase memory capacity (a hard disk), it is necessary to make hardware modifications to the machine. Also, since the machine is not modular, it has certain physical limitations. The physical dimensions of the machine also prevents easy transport.

A minor problem with the machine is the placement of the "on-off" switch since it is difficult to reach.

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ANNEX

CHECKLIST REPORT CARD

CHECKLIST REPORT CARD	YES	NO	NOT APPLICABLE
Is the system forgiving when you make a mistake?			
Is the hardware system dependable?			
Is the hardware system physically convenient (e.g. is it easy to move)?			
Are manuals and computer-based tutorial aids up-to-date?			
Is training continually available?			
Do you have a sense of closure when you have completed a task?			
Does the software help avoid confusion?			
Are software rules consistent?			
Are software rules easy to learn?			
Does the system expect you to know a lot about it before you use it?			
Are software commands logical and self-evident most of the time?			
Does the software keep you constantly oriented to your task?			
Are computer graphic displays neat, clean, and simple to follow?			
Is the computer system easy to set up?			

CHECKLIST REPORT CARD	YES	NO	NOT APPLICABLE
Is the computer system consistent?			
Does the system make minimal demands on human memory?			
Is the computer system documentation sufficient?			
Is the system easy to service?			
Does the computer software provide appropriate feedback?			
Is the software consistent?			
Is the software simple?			
Is the software easy to learn?			
Is the computer software documentation sufficient?			
Does the program and system match your skill level?			
Does the system sustain your orientation to the system?			
Do you know where to go to obtain the services of a qualified engineer to perform on-site maintenance?			
Are there local places where the machine can be brought for service?			

CHECKLIST REPORT CARD	YES	NO	NOT APPLICABLE
Must the machine be brought back to the factory for simple repairs?			
Is there anything that the average non-technical person can do to keep repair costs down and efficiency up?			

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APPENDIX D

DEVELOPMENT OF A CHECKLIST FOR THE EVALUATION OF THE SPATIAL DATA MANAGEMENT SYSTEM FOR BASIC SKILLS EDUCATION

by

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July 1984

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INTRODUCTION TO THE CHECKLIST

Purpose

The intent of this checklist is to assist key personnel involved in a transfer of new technology into a new setting/environment in the U.S. Army to manage and monitor the implementation of a new system. This checklist was designed to indicate the absence or presence of a variety of factors potentially relevant to an ongoing technology transfer activity.

Research has shown there are a wide variety of factors that are directly applicable to an evaluation of the success or failure of any technology transfer because of their broad comprehensive nature. The vast majority of technology transfer researchers note that the literature has catalogued and classified all the key and crucial factors/variables associated with technology transfer and/or implementation RDT&E (Davis, 1982; Freda, 1980; Kearsley, 1983; Markus, 1980; Pengov, 1977; Seidel et al, 1978; Shields, 1976; Swanson, 1980; and Waters & Laurence, 1982). Table D-1 contains a representative catalog of relevant and key factors that underlie the success of a dissemination of information and for eventual user acceptance of a training product (Shields, 1976).

These factors describe all the primary aspects of and influences on the entire technology transfer process. They range from concern with the characteristics of the technology, the organization, and individual members to the implementation process and external forces. A study of practically all speeches, reports, and studies examining technology transfer, in whole or in part, inevitably reveals a list of each author's considered list of key or major variables impacting and/or influencing technology transfer. To complete the list of factors requires consideration of the stages of the technology transfer process: adoption of the technology in pilot form by a relatively small target group or unit; implementation of the innovation with role clarification and program redesign as required within the implementing organization; and last, routinization (institutionalizing) of the technology including line-item budgeting, continuation training for new administrative and instructional personnel, etc. In essence, these factors form a "system picture" of a technology transfer process, particularly one involving the transfer of new technology.

One of the most significant problem areas that can arise in technology transfer is a failure on the part of the participant (sponsor, researcher, developer, and user) in a project to understand the nature of the project and its products. It is almost a universal finding that where the expectations of the user differ from those of the developer or supplier of the innovative system, the implementation of the system will fail, or at least will only be partially successful. If the researcher has in mind an implementation of a breadboard system or a trial based upon some satisfaction of research needs and hypotheses, then this should be clearly communicated to the user who must provide the subjects, the facilities, and the site for the testing of those hypotheses.

Table D-1. FACTORS WITHIN EACH OF THE MAJOR CATEGORIES OF VARIABLES WHICH MAY INFLUENCE TECHNOLOGY TRANSFER IN THE ARMY (Shields, 1976)

Innovation Factors	Organizational Factors	Individual Factors	Implementation Factors	External Factors
Type of Innovation (hard vs soft)	Size	Education/Training	Presence of a Change Agent	General Social Conditions in Society
Source of Innovation	Formal Structure	Intellectual Level	Communication Channels Used	General Political Conditions
Match with operating environment, capabilities of human operators and other elements of the system	Information Structure	Status in Group	Vigor of the Communications Effort	Critical Events, Crises and Revolutions
Reliability	Attitude Toward Authority	Alternatives	Form of Communications (Content)	Acting on the Adopting Organization
Complexity	Goals, Values, Customs	Attitude Toward Change	The Supplier	
Effectiveness	Cohesiveness	Attitude Toward Change Agent	Completeness of Innovation Package	
Documentation	Communication Patterns	Attitude Toward Authority	Implementation Delays	
Ease of Use	Communication with Change Agent	Self-Esteem	Prior Need	
Capital, Personnel and Time Requirements	Organizational Interdependency	Satisfaction with Intrinsic Motivators	Command Support	
Visibility	Resources	Cosmopolitanism	User Participation	
Adaptability		Exposure to Outside Attitudes	User Training	
		Attitude Toward Present Equipment/ System		
		Attitude Toward Innovation		
		Resources		

Continuous communication must be established and maintained with system users as well as with sponsoring agencies throughout the entire duration of the technology transfer. Even though initial agreements may be attained by written contracts or memoranda of understanding, personal and written communications are necessary thereafter to maintain these agreements. This is especially important when the new technology may disrupt the traditional procedures for administering instruction.

Design of Checklist

In an earlier contract (MDA903-79-C-0558) sponsored by the U.S. Army Research Institute for the Behavioral and Social Sciences, an untested checklist was developed based upon a literature review of research, development, testing, and evaluation efforts related to the transfer of technology, implementation, innovation, and product and research utilization. The disciplines/fields studied to produce the original checklist included:

1. Organizational science
2. Management science
3. Educational technology
4. Information and computer technology
5. Public administration
6. Political science
7. Sociology
8. Social and experimental psychology
9. Organization development

The list below states the categories in the original checklist and the total number of questions in each:

1. Planning	14
2. Organization	68
. Organizational/Institutional Systems	
. Organizational/Institutional Climate	
. Organizational/Institutional Resources	
. Organizational/Institutional Timing	
3. Technology Users	18
4. Communication Mechanisms	66
. Linkage	
. Technology Transfer Advisory Group	
. Technology Change Agent	
5. Characteristics of the New Technology	11
6. Training	32
7. Evaluation	28

The literature clearly emphases five (5) major areas of factors potentially relevant to a successful technology transfer. In order, they are:

1. Organization,
2. Technology Users,
3. Communication Mechanisms,
4. Training, and
5. Evaluation.

In order to produce a checklist to be tested, evaluated, and used in the field for the evaluation of the Spatial Data Management System for basic skills education, the categories were refined. These categories were defined specifically with the spatial Data Management System in mind as well as the particulars concerning Ft. Stewart, the first installation and evaluation site.

Below is a list of these five categories with brief descriptions of what each category is intended to measure during the actual installation, proctor training, and all technology transfer efforts and activities thus far.

1. Organization

   - Identification of User Organization (Education Center) policies affecting the technology transfer.

   - Issues and considerations affecting continued use (implementation) of the technology after adoption has been affected such as equipment maintenance, and resource allocation.

   - Issues and considerations affecting institutionalizing the technology such as designating staff slots and budget line items for incorporating the technology as part of the regular program.

2. Technology Users

   - Personnel readiness/acceptance of a new educational system.

3. Communication Mechanisms

   - Liaison with the user (Center) administrative and teaching staff.

   - Communication between the sponsors and the Center.

4. Training

   - Training and continuing education for Proctors using the new system.

   - Orientation and training for administrataive and teaching staff.

5. Evaluation

   - Effectiveness of technology transfer and implementation of the new system.

   - Stage by stage assessment: adoption, implementation, and institutionalization.

Checklist Format

Separate checklists were created for each of the primary groups/ parties directly involved in the technology transfer. This was done for a variety of reasons. For one, a number of questions are not applicable to all parties. Based upon the technology transfer literature reeview, there are at least three major groups involved in every technology transfer. We identified these three groups and designed a separate checklist for each:

1. HumRRO and ARI staff as Researcher/Developer,
2. Proctors using new system as Technology User,
3. Education Service Officer as Management/Administration.

Each checklist was designed so it could be completed in about 10 minutes. A small checklist consisting of some 25-30 questions (3-5 pages) is decidedly preferable to a 237-item questionnaire. A large-scale questionnaire form would be tedious to complete and unmanageable for the user.

Questions were clearly written with an explicit category in mind. Each question requires a "Yes/No/Don't Know/Not Applicable To Me" response. The checklist format used only requires that the person completing it mark the appropriate answer box.

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CHECKLIST FOR HUMRRO/ARI

Name _____ _____ (optional)

Title _____

Date _____

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A*
Has HumRRO determined the technical feasibility of applying the new technology in this enviornment?				
Has HumRRO communicated with all levels of Center staff (ESO and Proctors) to help ensure acceptance and effective use of the system?				
Do AEC Administrative personnel, e.g., the ESO, know the purpose of this project?				
Do the Proctors know the purpose of this project?				
Does the ESO have any familiarity with the new technology?				
Do the Proctors have any familiarity with the new technology?				

* N/A = not applicable to me.

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Does the ESO see a need for the new technology? of applying the new				
Do the Proctors see a need for the new technology?				
Does the ESO want the system to be successfully used?				
Do the Proctors want the system to be successfully used?				
If new technical knowledge is required, has this information been made available to the Proctors?				
If new technical knowledge is required, has this information been made available to the ESO?				
Have you identified how many Proctors you will train?				
Has an effective training program been developed for the Proctors?				
Have objectives for the Proctor training program been developed?				
Do you have skills and/or experience in training proctors/instructors?				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Is there a timetable for the implementation of the Proctor training program?				
Have you determined how soon Proctors will be able to train students?				
Have you created clear support mechanisms for the Proctors (e.g., telephone hotlines)?				
Was the ESO trained to use the system?				
Have AEC personnel been identified as responsible for continuing education of the Proctors?				
Did the AEC staff indicate they would demonstrate the system to military/civilian visitors?				
Was it easy to install the system?				
Was the AEC staff cooperative in the installation of the system?				
Did you encounter any requirements you did not foresee?				

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CHECKLIST FOR PROCTORS

Name _____ (optional)

Title _____

Date _____

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A*
Is there consensus in the Education Center about the goals of this project?				
Do you know the individuals/groups responsible for decisions affecting this project?				
Have you been involved in the planning stages of implementing this project?				
Have you participated in making decisions that directly affect your work?				
Is there an incentive system that rewards you for accepting and using the new technology?				
If new technical information is required, is it readily available to you?				

* N/A = Not applicable to me.

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Have there been any public announcements about this project?				
Do you feel a need to change from existing practices to implement the proposed innovation?				
Are there plans for continued use of the system?				
Are your ideas valued by the Center's administrative staff?				
Are the HumRRO representatives proficient trainers in how to use the new technology?				
Do the HumRRO representatives have good interperonals and communication skills?				
Have you identified how many students will use the system?				
Do you have skills and/or experience in managing computer-based instruction?				
Have effective training procedures been coordinated between yourself and HumRRO representatives?				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Do you know who to call if you are having problems with the system? Who? (Please list name(s) and their areas of expertise.				
Do you have sufficient knowledge and/or information about this project and how the system will be implemented?				
Do you know all the types of equipment the new system will require, including terminals, computing machinery, and videodisc players, etc?				
Does the military command on the Post perceive the system positively?				
Are the goals of this project compatible with the training and operational requirements of the Post?				

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CHECKLIST FOR EDUCATION SERVICE OFFICER AND STAFF

Name _____ (optional)

Title _____

Date _____

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A*
Is this system directly related to identifiable educational needs?				
Is there consensus in the Center about the goals of this project?				
Do you know the individuals/groups responsible for decisions affecting this project?				
Have these participants been identified and involved in this project:				
Yourself				
ARI				
HumRRO				
FORSCOM				

* N/A = Not applicable to me.

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Does the staff, including Proctors participate in making decisions that directly affect their work?				
Is there an incentive system for instructors that rewards acceptnace of the new technology?				
Do you have sufficient knowledge and/or information about this project and how the system will be implemented?				
If new technical information is required, is it readily available to the Center's staff?				
Is there a detailed budget for the extended use of this system?				
Does this budget include funds for:				
purchase of equipment				
repair and maintenance				
evaluation				
energy costs				
incentives				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Have you considered the following physical facility requirements:				
size of rooms				
lighting				
noise				
temperature				
location				
Is there a timetable for the extended use of the system?				
Have you identified the expenses for training Center personnel to operate the system?				
Have you identified what operating expenses will be required to continue using this system?				
for equipment maintenance				
for facilities				
for consumable supplies				
other _____				
Are there programs for continuing education for Proctors?				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Are there programs for continuing education for other Center staff?				
Have there been any public announcements (e.g., reports, newsletters, meetings) about this project?				
Is the Center committed to this project?				
Are there plans to incorporate this technology into your normal training program next FY?				
Are there instructors designated to use the technology as part of training this FY?				
Are there instructors designated to use the technology as part of training next FY?				
Is there funding for this in your budget for next FY?				
Is the funding part of a regular line item in your budget?				
Is there a staff designated to maintain the technology next FY?				
Is there funding for this in your budget for next FY?				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Is the funding in itself a regular line item in your budget?				
Is there a staff designated to maintain the technology next FY?				
Are there training programs in place to maintain understanding of the technology for:				
new personnel				
upgrading current personnel				
Do the Proctors have skills and/or experience in managing computer-based instruction?				
Have evaluation criteria for using this system been established?				
Can you identify the types of equipment the technology transfer will require, e.g.:				
terminals				
computers				
videodisc players				
other equipment _____				

Mark the appropriate box to indicate your answer to the following questions.

	Yes	No	Don't Know	N/A
Do you know the types and numbers of support personnel required for this system?				
Have decisions and actions been planned from the beginning of the project?				
Does the military command on the Post perceive the system positively?				
Have they received orientation training?				
Are the goals of the project compatible with the training and operational requirements of the Post?				
Can you list the command sequence for this project in terms of your organizational chart for the Center, the School and the Post? Please list this sequence below as you understand it _____ _____ _____ _____ _____ _____				